A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

AUGUST, 1937.

GENERAL PHYSICS.

ADSORPTION.

3303. Sorption of Carbon Monoxide by Alumina. N. M. Morozov. *Acta Physicochimica,* 6. 5. *pp.* 719–743, 1937. *In English.*—The existence of two kinds of sorption of CO on alumina in different temperature regions and with different heat effects and activation energies is shown. The sorption processes in both temperature regions are complex. Both in the case of sorption and in the case of desorption the general kinetics are determined by the stage of diffusion. It has been found from the temperature dependence of the velocity constant that at low temperatures the energy of activation of desorption is $E'_d=9900$ cal./mol., and at high temperatures the activation energy of sorption is $E_s=$ 19,100 cal./mol., and that of desorption $E'_d=27,400$ cal./mol. The heat effects of sorption computed from the isotherms are as follows: at low temperatures about 11,000—7000 cal. at high temperatures about 16,000—10,000 for various degrees of covering of the surface. It has been shown by analysis of the experimental results that the diffusion phenomenon which manifests itself in both temperature regions is a surface migration of adsorbed molecules from more active to less active spots of the surface. [See also Abstract 1888 (1935).] AUTHOR.

3304. Adsorption of Alkali by Charcoal. R. Burstein. *Acta Physicochimica,* 6. 3. *pp.* 371–374, 1937. *In German.*—It has not been possible to substantiate an earlier observation that a charcoal freed from gas at 950° C. is unable to adsorb Na-ions from 0·01 *N* NaOH solution, whereas a charcoal which has adsorbed H_2 at 300°–800° C. can adsorb alkali to an amount equivalent to the amount of H_2 adsorbed. The present work was carried out with a number of different kinds of charcoal. J. K.

3305. Exchange Adsorptions on the Surface of Barium Sulphate. I. M. Kolthoff and G. E. Noponen. *Am. Chem. Soc., J.* 59. *pp.* 1237–1239, *July,* 1937.—A new method is described for the determination of the specific surface of $BaSO_4$ which is based upon the exchange between chromate and sulphate ions in the surface of $BaSO_4$. It is shown that Pb ions exchange with Ba ions and iodate with sulphate ions in the surface of $BaSO_4$. AUTHORS.

3306. Properties of Hydrogen Films on Tungsten. R. C. L. Bosworth. *Cambridge Phil. Soc., Proc.* 33. *pp.* 394–402, *July,* 1937.—In a study of the properties of H_2 on W by the method of contact potentials the following points have been established: (1) The contact potential of a 92% covered surface of H_2 on W against bare W is 1·04 V., and the Richardson constants for such a surface are approximately, $A = 30$, $b = 5{\cdot}60$ V. (2) A film of D_2 is 20 mV positive relative to a similar H_2 film. (3) Over the range of temperatures and pressures used by Bryce in a study of the production of atomic H the films are nearly saturated, so that the production of atomic H is primarily due to a molecule striking a bare W atom one atom being adsorbed and the other going into the gas phase. (4) The condensation coefficient for H_2 molecules on cold W is 0·01. (5) The effective dipole moment of each H atom on the surface is $-0\cdot42$ Debye unit and is independent of the fraction of the surface covered. AUTHOR.

See also Abstracts 3430, 3647, 3789.

ATOMIC AND MOLECULAR STRUCTURE.

3307. Nuclear Forces. K. Nakabayasi. *Tohoku Univ., Sci. Reports*, 25. *pp.* 1141–1161, *March*, 1937. *In German.*—Nuclear binding energies are calculated, using as a first approximation wave functions of particles in a suitable parabolic potential field, and correcting for the error thus committed up to the second approximation. The results for the energy values are higher than those obtained with the variation method. R. P.

3308. Nuclear Physics. Part II. Nuclear Dynamics, Theoretical. H. A. Bethe. *Rev. Modern Physics*, 9. *pp.* 69–244, *April*, 1937.—A critical review of the present position dealing with the following: (ix) Nuclear processes as many-bodied problems. (x) Neutrons (slow and fast). (xi) α-Radioactivity. (xii) Scattering of charged particles by nuclei. (xiii) Disintegrations produced by charged particles, and (xiv) γ-rays. The treatment is mathematical, with references to the connected experimental results, details of which are to follow, and 616 references. [For Part I see Abstract 2929 (1936).] C. A. S.

3309. Statistical Calculation of Density of Energy Levels of Nuclei. C. van Lier and G. E. Uhlenbeck. *Physica*, 4. *pp.* 531–542, *July*, 1937. *In English.*—The calculation of Bethe [see Abstract 4435 (1936)] concerning the density of energy levels $p(E)$ of a nucleus has been extended assuming for the density of the levels of the individual particles an arbitrary function $\phi(\epsilon)$. The method of Darwin-Fowler, which seems especially adapted to the problem, has been used throughout. The influence of the incompleteness of the degeneration is investigated for the case of equidistant individual energy levels. The connection is shown with problems in the *partitio numerorum*. AUTHORS.

3310. Artificial Radioactivity. Part II. K. Diebner and E. Grassmann. *Phys. Zeits.* 38. *pp.* 406–425, *June* 1, 1937.—Comprehensive survey of the results hitherto obtained on artificial radioactivity produced by the bombardment of elements by (1) α-particles, (2) protons, (3) deuterons, (4) neutrons, (5) electrons, (6) γ-rays. [For Part I see Abstract 2938 (1936).] F. C. C.

3311. Induced Radioactivity of Potassium. D. G. Hurst and H. Walke. *Phys. Rev.* 51. *pp.* 1033–1037, *June* 15, 1937.—The paper reports a study of certain induced radioactivities associated with K. It is shown that the half-life of K^{42} is $12\cdot4 \pm 0\cdot2$ hr. In addition to the well-established deuteron and slow neutron reactions K^{42} is also formed by the reactions $Sc^{45} + n^1 \rightarrow K^{42} + He^4$ and $Ca^{42} + n^1 \rightarrow K^{42} + H^1$. This last appears to have a relatively small probability. No evidence was found for the reaction $Ca^{44} + H^2 \rightarrow K^{42} + He^4$. Fast neutron irradiation of K yields active Cl and A^{41} by the transmutations $K^{39 \text{ or } 41} + n^1 \rightarrow Cl^{36 \text{ or } 38} + He^4$; $K^{41} + n^1 \rightarrow A^{41} + H^1$. There was no indication of the presence of A^{39} in the activated samples. α-particle bombardment of Cl yields K^{38} according to the reaction $Cl^{35} + He^4 \rightarrow K^{38} + n^1$. This isotope of K decays with a half-life of $7\cdot7_5 \pm 0\cdot1_5$ min., emitting positrons having a maximum energy of about 2 eMV and γ-rays which may be annihilation radiation only. K^{38} is also obtained by deuteron bombardment of Ca thus: $Ca^{40} + H^2 \rightarrow K^{38} + He^4$. AUTHORS.

3312. Sargent Curves for Artificially Radioactive Substances. A. C. G. Mitchell. *Phys. Rev.* 52. *pp.* 1–5, *July* 1, 1937.—Sargent curves have been plotted for a number of elements whose end-points have been determined by extrapolation of the Konopinski-Uhlenbeck curves. The points lie on three smooth curves whose shapes agree with theoretical calculations based on the K–U theory. The relative values for the transition matrix moments are obtained and a discussion of the spins of the radioactive elements is given. AUTHOR.

3313. Law of Sargent. G. E. Uhlenbeck and H. Kuiper. *Physica,* 4. *pp.* 601–605, *July,* 1937. *In English.*—The theoretical dependence of the decay constant of β-radioactivity from the maximum energy and from the nuclear charge is computed and compared with experiment. This is applied to find the ratio of the number of electrons and positrons in the branch reaction of ${}^{64}_{29}\mathrm{Cu}$. AUTHORS.

3314. Disintegration of Uranium by Neutrons. L. Meitner, O. Hahn, and F. Strassmann. *Zeits. f. Physik,* 106. 3–4. *pp.* 249–270, 1937. —The details of the three methods by which U can be disintegrated by neutrons are investigated.

$$\text{(1)}\ \mathrm{U} + n \rightarrow {}^{10''}_{92}\mathrm{U} \xrightarrow{\beta} {}^{2\cdot 2'}_{93}\text{Eka Re} \xrightarrow{\beta} {}^{59'}_{94}\text{Eka Os} \xrightarrow{\beta} {}^{66\mathrm{h}}_{95}\text{Eka Ir} \xrightarrow{\beta} {}^{2\cdot 5\mathrm{h}}_{96}\text{Eka Pt} \xrightarrow{\beta} {}_{97}\text{Eka Au ?}$$

$$\text{(2)}\ \mathrm{U} + n \rightarrow {}^{40''}_{92}\mathrm{U} \xrightarrow{\beta} {}^{16'}_{93}\text{Eka Re} \xrightarrow{\beta} {}^{5\cdot 7\mathrm{h}}_{94}\text{Eka Os} \xrightarrow{\beta} {}_{95}\text{Eka Ir ?}$$

$$\text{(3)}\ \mathrm{U} + n \rightarrow {}^{23'}_{92}\mathrm{U} \rightarrow {}_{93}\text{Eka Re ?}$$

From measurements of the energy required to effect the different disintegrations it is deduced that the first two require fast neutrons while the third requires neutrons having thermal energy. No resonance levels are observable in the energy range between thermal energies and the full neutron energy. The third disintegration is a typical resonance process, requiring neutrons with an energy of 25 ± 10 V. The absorption coefficient for the resonance neutrons is 3 cm^2./gm. Using a cloud chamber, the maximum energy of the electrons released from Eka Re during its 16 min. decay is shown to be more than 3×10^6 V. The collision area of the neutrons responsible for process (2) is given as $1\cdot 6 \times 10^{-25}\,\mathrm{cm}^2$. Using the observed decay values and the total activity it is deduced that processes (1) and (2) are of comparable probability. The collision area for fast neutrons for the combined processes is measured as $3\cdot 5 \times 10^{-25}\,\mathrm{cm}^2$. No α-particle disintegration is observed in any of the three processes. J. E. R. C.

3315. Generation of Radioactive Elements by the Bombardment of Lithium and Magnesium with ThC′-α-Radiation. A. Eckardt. *Ann. d. Physik,* 29. 6. *pp.* 497–513, *July,* 1937.—The author deals with the problem of the sequence of products which can arise when Li is bombarded with X-rays from ThC′. It is discussed whether artificial radioactivity is possible since an experimental proof by means of the Geiger-counter has been sought in vain. Similar experiments have also been made with Mg, from which it has been established that the curve of fading activity consists at least of two components. The particles emitted during the disintegration were investigated in a specially regulated Wilson chamber for charge and velocity, whereby certain proof was obtained that the observed radioactivity was to be ascribed to ${}_{13}\mathrm{Al}^{28}$ and ${}_{14}\mathrm{Si}^{27}$. The half-life periods of both nuclei were determined. Based on the new data obtained from the Wilson chamber, it was found possible to investigate still more accurately the electron- and positron-spectra and to establish the limits of the energy distribution. Full experimental details are included.

H. H. Ho.

3316. Extraction of Artificially Radioactive Phosphorus from a Mixture with the Stable Isotope. O. Erbacher and K. Philipp. *Zeits. f. phys. Chem.* 179. *Abt. A.* 4. *pp.* 263–274, 1937.—A solution of triphenyl phosphate in benzene is irradiated with slow neutrons. The artificially radioactive phosphorus atoms are liberated as ions and may therefore be extracted by the addition of pure water or a small quantity of charcoal. In both cases, about 4 × 10^{-7} gm. of active phosphorus is extracted, representing about one ten millionth part of the irradiated stable isotope.

F. C. C.

3317. Theory of Collision of Neutrons with Deuterons. H. Yukawa and S. Sakata. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 542–551, *June*, 1937. *In English.*—The problem of the neutron-deuteron collision is reduced to a simple form by taking the structures of ^{2}H and ^{3}H into account and neglecting the forces depending explicitly on the spin. The form of the effective potential hole is determined by comparing the estimated value of the cross-section of scattering of slow neutrons by deuterons with that obtained experimentally. The cross-section of capture is found to be small in agreement with the experiment. The energy dependence of the scattering cross-section is also discussed. The theory of Fermi concerning the effect of the chemical binding on the scattering of slow neutrons is extended to the more general case and a necessary limitation of the theory is discussed. The cross-section for thermal neutrons is found to be nearly twice as large as that for neutrons of several volts. Theoretical reasons for the small contribution of the deuteron to the slowing down are considered.

AUTHORS.

3318. Scattering of Slow Neutrons by Atomic Lattices of Crystals. G. C. Wick. *Phys. Zeits.* 38. *pp.* 403–406, *June* 1, 1937—The scattering of neutrons by crystals is examined mathematically and a formula for the effective cross-section in terms of the cross-section at very low temperatures, is derived. The results are compared with those for the corresponding problem of X-ray scattering.

F. C. C.

3319. Scattering on Neutrons in Matter. Part V. L. S. Ornstein. *K. Akad. Amsterdam, Proc.* 40. 6. *pp.* 464–470, 1937.—In a continuation of several previous papers on this subject [see Abstract 426 (1937)], the distribution in direction of neutrons scattered by protons is discussed using a more general law than that used in the earlier papers, namely that the original direction of the neutron beam is an axis of symmetry for the directions of the scattered neutrons. An expression for the probability law for the direction θ after n collisions is developed by the use of Legendre polynomials. Some of the expressions obtained in Part I are again deduced using the more general assumptions.

G. O. B.

3320. Iso-Energetic Neutrons. E. T. Booth and C. Hurst. *Roy. Soc., Proc.* 161, *A. pp.* 248–260, *July* 15, 1937.—The mean free path in paraffin wax of the iso-energetic neutrons obtained by bombarding D_2 with D-ions has been measured and found to be $4\cdot 6 \pm 0\cdot 9$ cm. The elastic scattering cross-section, *viz.* $(1\cdot 8 \pm 0\cdot 4) \times 10^{-24}$ cm^2., derived from this determination agrees well with Wigner's theoretical predictions. Attempts have been made with these $2\cdot 5 \times 10^6$ eV neutrons to produce nuclear reactions in which either a proton or an α-particle is emitted. The transmutation of S to form P^{32} and a proton was the only hitherto unreported reaction of this kind to be observed. The number of neutrons emitted by the h.v. source has been compared with the numbers emitted by Be photo-neutron and Rn-Be sources. Neutron capture reactions were observed to proceed in easily measurable amounts with the D + D neutrons and the activities so produced have been compared with those arising from the Ra-Be photo-source under similar conditions of exposure. The intercomparison of source strengths enabled a determination of the capture cross-section of Ag for $2 \cdot 5 + 10^6$ eV neutrons to be made. The value found was 7×10^{-25} cm². AUTHORS.

3321. Effective Cross-Sections for Slow Neutrons. R. Fleischmann. *Zeits. f. Physik,* 105. 11–12. *pp.* 698–703, 1937.—Using the experimental results of various other workers the author investigates the possibility of a functional relationship between the probability σ_B with which the resonance neutrons from a given substance are absorbed in boron, and the probability σ_C with which the thermal neutrons (group C neutrons) are absorbed. A smooth curve is obtained connecting σ_B and σ_C. G. O. B.

3322. Polarity of Chemical Bonds. M. L. Huggins. *J. Chem. Phys.* 5. *pp.* 527–529, *July,* 1937.—It is shown that polar bonds can be as well considered to be resonating between two covalent states as between one covalent state and an ionic state. The limitation on the number of K electrons in an isolated H atom does not prevent it from being bonded at the same time to two other atoms, provided they are sufficiently electronegative. Likewise, a C or N atom, suitably surrounded by electronegative atoms, can hold more than four (bonding), electropairs in its valence shell. It is suggested that Pauling's "magnetic criterion for bond type" does not distinguish between covalent bonds and "ionic bonds," but between covalent bonds of different polarity. AUTHOR.

3323. Valency Angle and Effective Radius of Bound Atoms. H. A. Stuart. *Zeits. f. phys. Chem.* 36. *Abt.B.* 2. *pp.* 155–162, 1937.—The connection between the magnitudes of the effective radii and the valency angle of molecules of type AX_2 and AX_3 is dealt with and it is shown that the normal valency angle for O, S and N atoms is 90° and that larger angles such as the often observed one of 110°, are to be attributed to repulsion forces at the O atom. The effective radii are given for a series of atoms. It is shown further that practically only deformations of the valency angle occur under the influence of repulsive forces between the atoms of a molecule, and that larger deformations of the electronic sheaths do not in general take place. H. H. Ho.

3324. Structure of Diborane. S. H. Bauer. *Am. Chem. Soc., J.* 59. *pp.* 1096–1103, *June,* 1937.—Electron diffraction photographs of diborane indicate that this compound has an ethane-like structure with the B–B distance equal to 1·86 ± 0·04 Å and the B–H distance 1·27 ± 0·03 Å; the valence angles of the boron atoms are found to be tetrahedral within three degrees. An electron configuration compatible with the large interatomic distances is presented both in terms of the atomic and molecular orbital modes of description and the conclusion is reached that the stability of B_2H_6 relative to BH_3 is due to the resonance energy made available through the full use of the four orbitals of boron. AUTHOR.

3325. Molecular Structures of 2,3-Epoxybutanes. L. O. Brockway and P. C. Cross. *Am. Chem. Soc., J.* 59. *pp.* 1147–1148, *June,* 1937.—A correction. [See Abstract 434 (1937).]

3326. Electron Diffraction Investigation of Hydrocarbons. L. Pauling and L. O. Brockway. *Am. Chem. Soc., J.* 59. *pp.* 1223–1236, *July,* 1937.—Values found for interatomic distances and bond angles in the 13 hydrocarbons studied are given. The C-C distance is found to have the constant value 1·54 ± 0·02 Å, being unaffected by the presence of an adjacent double bond or benzene nucleus (provided that it does not form part of a conjugated system). The C = C distance in allene and acetylene has the value 1·34 Å. This is 0·04 Å less than that formerly given by the table of covalent radii, which has accordingly been revised. The effect of the revision on the bond distance-resonance curve is discussed. AUTHORS.

3327. Electron Diffraction of Inorganic Halides. A. H. Gregg, G. C. Hampson, G. I. Jenkins, P. L. F. Jones and L. E. Sutton. *Faraday Soc., Trans.* 33. *pp.* 852–874, *July,* 1937.—Electron diffraction is applied to the study of a number of inorganic halide molecules, and the results, combined with those of other workers, show that while the interatomic distances in the fifth group iodides are equal to or greater than the sums of the Pauling-Huggins covalent radii, those of the bromides show a shortening of 1–2 %, chlorides 2–4 % and fluorides 7–13 %. The mercuric halides, however, show greater shortening in the iodide than in the chloride, while boron halides appear to exhibit mixed behaviour. It is suggested that there are at least two influences causing the observed shortenings, (1) the possibility, with Hg and B, of resonance of the ordinary structures with others in which the octet is completed by formation of coordinate links from a halogen atom to the central atom, and (2) the polar character of the bonds which may directly or indirectly permit double-bonded structures without increase of the octet on the central atom. It is shown that the constancy of the valency angles in the fifth group tri-halides may possibly be due to complicated compensations of several opposing tendencies, but doubt is expressed of the adequacy of this explanation. A. G. Q.

3328. Formation of Complexes in Salt Melts. G. Wirths. *Zeits. f. Elektrochem.* 43. *pp.* 486–491, *July,* 1937.—Part I deals with the formation of complex anions in fused mixtures of $KCl + PbCl_2$ as well as in pure $PbCl_2$. It is established that the lead in fused mixtures of $PbCl_2$ with KCl is partly united in a complex anion, and that the proportion of this anion increases with the content of KCl in the fused mixture. No formation of complex chlorine-lead anions could be detected in pure molten $PbCl_2$. Part II deals with the existence of a subchloride in a $CdCl_2$-melt saturated with Cd. On account of the close analogy in behaviour between calomel and the Cd-$CdCl_2$-melt as well as from the electrolytic results now described, it is concluded that the subchloride Cd_2Cl_2 is formed in the Cd-$CdCl_2$-melt. Full experimental details are given. H. H. Ho.

3329. Change in Water Equilibrium and Hydration in Solutions of Typical Electrolytes. C. S. Rao. *Phil. Mag.* 24. *pp.* 87–97, *July,* 1937.—The three strong electrolytes, $NaNO_3$, H_2SO_4 and HCl, are studied in their aqueous solutions, together with the pure solvent in each case, under identical experimental conditions, with a view to estimating quantitatively the changes that take place in the constitution of water as solvent compared with that of pure water. Analysis of the intensity curves of the Raman band for water in the pure solvent and in the solution is done for each of the electrolytes studied, with the following results: (I) $NaNO_3$ changes trihydrol into monohydrol, with no especial effect on dihydrol.

(II) H_2SO_4 changes dihydrol into mono- and trihydrol; further at 8N concentration hydrates with 1 and 3 molecules of water of hydration seem to preponderate over the other types. (III) HCl exhibits an increase in the component due to the double molecules, with a corresponding decrease in that of the triple molecules, and as such points to the conclusion that it changes trihydrol into dihydrol, and that at 7·65 N concentration hydrates with two associated water molecules are present in greater numbers. [See also Abstract 3246 (1935).] AUTHOR.

3330. Classification of Molecules in Liquids. K. L. Wolf, H. Frahm and H. Harms. *Zeits. f. phys. Chem.* 36. *Abt.B.* 4. *pp.* 237–287, 1937.—An attempt is made to base the classification of molecules in liquids on measurements of orientation-polarisation, heat of admixture and densities of liquid mixtures, in particular of hydrocarbons, with each other and of mixtures of aliphatic alcohols and acetone with dipole-free liquids. Steric influences and temperature with respect to association and solvation as well as the problem of mixture anomalies are taken into consideration. The energies of dissociation and solvation are determined and comparative data are included for the de-associating effect of dipole-free liquids on alcohols. H. H. Ho.

3331. Ostwald-Viscometer Determination of Higher Molecular Weights. G. V. Schulz. *Zeits. f. Elektrochem.* 43. *pp.* 479–485, *July*, 1937.—This paper is the 160th communication on highly polymerised compounds. If the Ostwald viscometer be employed for the evaluation of the molecular weight of a highly polymerised substance, errors can arise by neglect of the Hagenbach correction and also by disturbance of the isotropic direction-distribution of the dissolved particles as a result of an excessive velocity gradient. It is shown how the two sources of error may be reduced to a negligible amount by a suitable adjustment of the dimensions of the viscometer, and data are given for several of the ordinary solvents. Comparative results are also included for the Ubbelohde viscometer. H. H. Ho.

See also Abstracts **3349, 3508, 3511, 3512, 3513, 3514, 3559, 3587, 3592, 3594, 3600, 3601, 3610, 3632, 3651, 3705, 3714, 3723, 3479, 3751.**

COLLOIDS.

3332. Tungstic Oxide Sols. Part II. F. Eirich. *Kolloid Zeits.* 79. *pp.* 182–190, *May*, 1937.—A new type of tungstic oxide sol is prepared by the peptisation of tungstic oxide with sodium tungstate. The sols are defined by analysis, conductometric and potentiometric titration, and their dissociation constants are determined. Their structures are discussed. Thirty-five papers are referred to. [See also Abstract 545 (1935).] J. K.

3333. Electrochemical Experiments on Highly-Purified Lyophilic Sols. W. Pauli and L. Palmrich. *Kolloid Zeits.* 79. *pp.* 174–181, *May*, 1937.—Agar sols are obtained in a purified, ash-free condition by electrodialysis and electrodecantation, and the same tests are applied as in previous investigations on gum arabic and silicic acid sols. It is considered probable that a complex containing 3 galactose groupings, one of which is sulphonated, is obtained. [See Abstract 2323 (1937).] J. K.

3334. Lyophilic Properties of Cellulose Derivatives. K. Kanamaru and T. Kohno. *Kolloid Zeits.* 79. *pp.* 190–208, *May*, 1937.—An experimental and theoretical work on the electrokinetic properties at their boundary surfaces of sols of cellulose derivatives such as nitrocellulose and acetyl cellulose at different concentrations in single and mixed solvents. J. K.

3335. Change of Sign of Electric Charges in Disperse and Related Systems. G. Antonoff. *Kolloid Zeits.* 79. *pp.* 331–334, *June*, 1937.—During the electrolysis of acidified suspensions of auriferous ores, there separates at the anode a complex precipitate consisting mainly of Ca and Fe whose Au-like appearance has been established as due to a definite O-content. This complex precipitate is very stable, resisting attack by single acids but like Au being soluble in aqua-regia or in HCl containing H_2O_2; it is decomposed on heating. The formation of this complex appears only to be possible when its components are present in the solutions within a definite narrow range of concentration. By changing the acidity of the solution, the same precipitate can sometimes be separated at the kathode. H. H. Ho.

3336. Orderly Coagulation of Aerosols. Part II. D. Beischer and A. Winkel. *Naturwiss.* 25. *pp.* 420–423, *June* 25, 1937.—The present work deals with the formation of Ni and Fe aerosols by the decomposition of their respective carbonyls and the coagulation of these aerosols below and above the Curie-temperature. (For Part I see Abstract 1406 (1936).] J. K.

3337. Coagulation of Latices by Polar-Nonpolar Liquids. F. K. Daniel, H. Freundlich and K. Söllner. *Faraday Soc., Trans.* 33. *pp.* 890–894, *July*, 1937.—Certain latices are very difficult to coagulate, *e.g.*, Abiarana gutta-percha latex. Such diluted latices may be coagulated by shaking them with organic liquids not miscible with water in all proportions, if the liquids form a second liquid phase and their molecules have a polar-nonpolar structure. Nonpolar liquids do not coagulate such diluted latices in this way. J. K.

3338. Influence of Temperature on the Elasticity of Gelatin. D. Teodorescu. *Soc. Roumaine Phys., Bull.* 38. 68. *pp.* 37–45, 1937.—*In French.*—The influence of temperature on the structure of lyogel of gelatin and on the modulus of rigidity of gelatin is studied and the experimental results obtained are compared with theoretical figures as derived from several considered formulæ. With increase of temperature gelatin passes directly from coagel to a suspension without traversing the lyogel phase. Reference is made to an earlier paper [see Abstract 1435 (1937)]. J. K.

3339. Elasticity of Rubber. E. Guth and H. Mark. *Naturwiss.* 25. *pp.* 353–359, *June* 4, 1937.—A general and historical paper in which the work of several investigators is discussed. Curves are given and considered for (1) elongation of a weakly vulcanised rubber, (2) modulus of elasticity of raw rubber as a function of stretch, (3) hysteresis diagram of raw rubber according to Ornstein and co-workers. (4) $\partial U/\partial l$ at constant temperature, where U is the internal energy, as a function of the degree of elongation. J. K.

3340. Colloidal Structure of Rubber in Solution. S. D. Gehman and J. E. Field. *Indust. and Engin. Chem.* 29. *pp.* 793–799, *July*, 1937.—Measurements are reported of the intensity and depolarisation of the light scattered transversely by solutions of purified rubber in various solvents. Viscosity measurements on the same solutions are included. The viscosity is shown to be a function of the dielectric polarisation of the solvent. Experimental results are compared with the expectations on the basis of various theories of light scattering. Intensity and depolarisation measurements are consistent in indicating that the colloidal units responsible for the light scattering are large compared to the wave-length of light, increase in size as the concentration is increased, and vary in size for the different solvents. The scattering is best explained by assuming in the solutions anisotropic scattering units similar in nature to the cybotactic groups of a liquid which may interlock sufficiently to give a continuous structure throughout the solution. AUTHORS.

3341. Cellulose Micelles. O. Kratky and H. Mark. *Zeits. f. phys. Chem.* 36. *Abt.B.* 2. *pp.* 129–139, 1937.—Various proposals concerning the micelle structure of cellulose are briefly reviewed. In place of older theories based on individual micelles favour is given at present to the theory depending upon chief valency chains. It is shown that X-ray graphical methods are unable to help in deciding between the two kinds of possible structure. The values of the elastic modulus of cellulose are particularly discussed as these favour the chief valency chains. [See Abstract 530 (1937).] J. K.

See also Abstracts 3365, 3369, 3373, 3374, 3422, 3530, 3680.

CRYSTAL STRUCTURE AND PROPERTIES.

3342. Nuclear Crystallisation. E. Andronikaschwili. *Acta Physicochimica,* 6. 5. *pp.* 689–700, 1937. *In German.*—Equilibrium conditions connecting nuclear size and extent of supercooling are investigated theoretically and found to satisfy the relation $r = 2\gamma/\rho.dS.dT$ where ρ is density of the liquid, S entropy; this is analogous with the Thomson formula. A curve is given showing the relation between work of formation of a nucleus and its size; under certain conditions of supercooling, formation is theoretically possible without external work. The mechanism of development of existing nuclei in supercooled liquids is studied, and the author refuses to recognise as valid the idea that the work required is a measure of the stability of super-saturated solutions, as in the Gibbs-Volmer relation $W = 16\pi\gamma^3\ M^2/3R^2\ T^2\ \rho_1^2\ (\log_e\ p_l/p_s)^2$, ρ_1 being the density of the liquid. Fluctuations of temperature and density necessary for development of an equilibrium nucleus, without external work, are discussed for given conditions; practical values being calculated for Hg from established data. D. R. H.

3343. Theory of X-Ray Diffraction in Crystals. M. Renninger. *Zeits. f. Krist.* 97. 1–2. *pp.* 95–106, 1937.—The dependence of various interference magnitudes upon the angle between the crystal surface and reflecting plane in unsymmetrical Bragg reflection is discussed, and also the relationship between reflecting power and structure factor (F) for ideal crystals in the transition to smallest F-values. A. G. Q.

3344. Distribution of Charge in the Diamond Lattice. M. Renninger. *Zeits. f. Krist.* 97. 1–2. *pp.* 107–121, 1937.—It is shown that the structure factor F for the forbidden diamond reflection 222 lies within the range 1·1 to 2·7 electrons/unit cell (F_{000} = 48 electrons/unit cell), and that the most probable value is near the lower limit. This is about four times the value deduced by Ewald and Hönl from wave-mechanical calculations of the charge distribution in the diamond lattice [see Abstract 4259 (1936)]. Further, it is confirmed that the 622 reflection, which like the 222 is "forbidden," does not appear, and from the sensitivity of the intensity measurements it is deduced that the 622 structure factor must be less than about 0·2 electron/unit cell. A. G. Q.

3345. Electronic Structure of Alloys. J. C. Slater. *J. of Applied Physics*, 8. *pp.* 385–390, *June*, 1937.—According to modern ideas a metal may be regarded as a sea of free electrons in which are floating enough positively charged ions to make the whole system electrically neutral. Different metals vary in the fraction of total volume taken up by the positive ions and in the energy distribution of electrons in the structure. From these considerations, differences in such properties as heat of sublimation, compressibility and melting point may be explained, and this is done for the ferromagnetic elements Fe, Co, Ni, and their alloys. Some of the magnetic properties of these metals are also worked out on a theoretical basis. J. T.

3346. Lattice Constant of Iron. P. Möller. *Zeits. f. techn. Physik*, 18. 6. *pp.* 167–169, 1937.—A graphical method is described for the determination of the lattice constant of Fe, for use in the measurement of small changes of lattice size due to strain. Co-K radiation is used and Au is employed as a reference substance. J. T.

3347. Superlattice in β Brass. F. W. Jones and C. Sykes. *Roy. Soc., Proc.* 161*A. pp.* 440–446, *Aug.* 3, 1937.—X-ray photographs of β brass taken with Zn radiation show superlattice lines. The intensity and position of the lines are in agreement with the conclusion that β brass has an ordered distribution of atoms at room-temperature. AUTHORS.

3348. X-Ray Investigations of the Mn-As System. Part I. H. Nowotny and F. Halla. *Zeits. f. phys. Chem.* 36. *Abt. B.* 4. *pp.* 322–324, 1937.—In addition to the compound MnAs with NiAs structure, the existence of a tetragonal Mn_2As lattice is established, isomorphous with Mn_2Sb. Space group D^7_{4h}, $a = 3 \cdot 76$, $C = 6 \cdot 265$ Å. In the alloys rich in Mn another phase (probably Mn_3As) appears and the possibility of further phases is not excluded. L. A. W.

3349. Crystal and Molecular Structures of CI_4 and CBr_4. C. Finbak and O. Hassel. *Zeits. f. phys. Chem.* 36. *Abt. B.* 4. *pp.* 301–308, 1937.—The crystals structures of CI_4 and CBr_4 are determined by X-ray powder and rotation methods. It is shown that at ordinary temperatures CI_4 is not cubic, as suggested by earlier workers, but monoclinic and isomorphous with CBr_4 even just below the melting point. Electron diffraction is employed to determine the molecular structures in the vapour phase, and it is found that in the tetrahedral CI_4 molecule the interatomic distances are $I - I = 3 \cdot 459$ and $C - I = 2 \cdot 12$ Å, while in CBr_4 the $C - Br$ distance is $1 \cdot 93$ Å. A. G. Q.

3350. Structure of Solid H_2S. S. C. Sirkar and J. Gupta. *Indian Journ. Phys.* 11. *pp.* 119–121, *May*, 1937.—An attempt has been made to determine the positions of H atoms in the unit cell of solid H_2S by correlating the results of investigation of the Raman spectrum with those of the X-ray analysis of the crystal. It is pointed out that the molecule is not linear in the solid state as concluded by previous workers from results of X-ray analysis, but it is bent having the angle between the two S-H bonds equal to about 109° and the positions of the H atoms in the unit cell are exactly the same as those for the F ions in the crystals of CaF_2. The space group is O^5_h. AUTHORS.

3351. Structure of Fibrous Tourmaline. S. R. Swamy and K. Y. S. Iyengar. *Indian Acad. Sci., Proc.* 5 *A. pp.* 419–422, *May*, 1937.—The structure of a fibrous modification of tourmaline has been investigated by methods of X-ray diffraction. The fibrous modification is found to have essentially the same unit cell dimensions as the unmodified core of the mineral. In the fibrous modification the tourmaline crystallites are found to be oriented fibrously, the *c* axis being the fibre axis. The *a* axes are oriented at random. AUTHORS.

3352. Structure of Cadmium Nitride. M. Bassière. *Comptes Rendus*, 204. *pp.* 1573–1574, *May* 24, 1937.—Faintly yellow crystals are obtained when solutions of cadmium nitrate and sodium nitride are mixed in stoichiometric proportions and the precipitate which forms slowly is filtered off, the filtrate being allowed to evaporate. Analysis of the crystals shows that they are extremely pure and it is found that they are highly explosive. The crystals are orthorhombic, the faces developed being {001} and {111}. X-ray analysis gives the following parameters for the unit cell, $a = 7{\cdot}82 \pm 0{\cdot}02$, $b = 6{\cdot}46 \pm 0{\cdot}03$, $c = 16{\cdot}04 \pm 0{\cdot}08$ Å. There are 8 mol. per cell and the observed density is 3·24 (20° C). The space group is D_{2h}^{5} — *Pbca*. J. I.

3353. Structure of Caesium Nitrate. C. Finbak and O. Hassel. *J. Chem. Phys.* 5. *pp.* 460–461, *June*, 1937.—X-ray and optical examinations of $CsNO_3$ at various temperatures show that the crystals are cubic between the transition point (161° C) and the melting point. Single crystals are not destroyed by heating above the transition temperature (to 200° C) and cooling to room-temperature. The results suggest that the positions of the Cs^+ ions are very little altered during the transition. The high temperature cubic form has a parameter of 4·49 Å, and so it is concluded that the low temperature form is pseudo-cubic with a parameter approximately 4·45 Å. If hexagonal symmetry is assumed the authors show that the most probable space group in C_{3v}^{2}. J. I.

3354. Structure of Glass. A. Ganguli. *Zeits. f. Krist.* 97. 1–2. *pp.* 88–90, 1937. *In English.*—A brief discussion of the various forces that retain glass in the amorphous, "supercooled liquid" or "quasi-colloidal" state, and affect its rate of devitrification. C. A. S.

3355. Structure of β-Alumina. C. A. Beevers and M. A. S. Ross. *Zeits. f. Krist.* 97. 1–2. *pp.* 59–66, 1937. *In English.*—β-Alumina has been shown chemically to be $Na_2O \cdot 11Al_2O_3$. It is shown now that this formula, as also $K_2O \cdot 11Al_2O_3$ for the corresponding K compound, is in agreement with the X-ray analysis. Both are hexagonal, and the unit cells with *a* 5·584, *c* 22·45 for the Na, and *a* 5·584, *c* 22·67 Å for the K compound, each contains two molecules; space group C6/*mmc* (D_{6h}^{4}). The structure consists of blocks of the thickness of four close-packed layers of cubic close-packed O atoms held together by Al atoms, adjacent blocks being held together by a layer of O and alkali metal atoms not close-packed. The structure is figured. C. A. S.

3356. Carbon-Oxygen Distance in Calcite and the Nitrogen-Oxygen Distance in Sodium Nitrate. N. Elliott. *Am. Chem. Soc., J.* 59. *pp.* 1380–1382, *July*, 1937.—A reinvestigation of the parameters of calcite and sodium nitrate is carried out using data obtained from Laue photographs. The parameters found are 0·2635 for calcite and 0·2394 for sodium nitrate. These values lead to the interatomic distances 1·313 Å for the C-O bond and 1·210 Å for the N-O bond. A comparison with the distances predicted by Pauling, Brockway, and Beach [see Abstract 377 (1936)] is made, and agreement found for the carbonate ion. The short N-O distance is discussed in relation to the effect of resultant charge of an atom on its covalent radius. AUTHOR.

3357. Structure of Pentaerythritol. F. J. Llewellyn, E. G. Cox, and T. H. Goodwin. *Chem. Soc., J. pp.* 883–894, *June,* 1937.—By means of quantitative X-ray measurements the structure of the tetragonal crystals of pentaerythritol has been completely determined. The interatomic distances within the molecule are C-C = 1·50 Å and C-O = 1·46 Å, and the deviations of the bond angles from the tetrahedral value of 109½° are negligible. Each OH group is linked to two others in neighbouring molecules by " hydroxyl bonds " of length 2·69 Å, in such a way that a layer structure with pronounced basal cleavage results. AUTHORS.

3358. Spherulites. E. v. Lengyel. *Zeits. f. Krist.* 97. 1–2. *pp.* 67–87, 1937.—The production of spherulites is described with 21 figures of such formations from $NaHCO_3$, $CaCO_3$, $MnSO_4 \cdot 4H_2O$, $K_2Cr_2O_7$, and $Na_2C_2O_4$. For their production, apart from a natural inclination thereto (many substances, *e.g.*, KCl, KI, KNO_3, $KClO_3$, K_2CrO_4, $KMnO_4$, $K_4Fe(CN)_6$, $K_3Fe(CN)_6$, etc., do not form them at all), the dominating circumstance is a high temperature (60°–110°) and consequent rapid evaporation and/or dehydration (*e.g.*, formation of various SiO_2 spherulites). The point at which temperature is highest, whether due to the position of the source of heat, or the presence of a particle, *e.g.*, of metal, of lower specific heat, becomes the centre of a spherulite, the " contour lines" of decreasing temperature forming concentric rings. C. A. S.

3359. Elastic Properties of Mother-of-Pearl. P. S. Srinivasan. *Indian Acad. Sci., Proc.* 5*A. pp.* 463–483, May, 1937.—Measurements are made of the elastic properties of mother-of-pearl obtained from a number of molluscan shells. In general it is found that the Young's modulus in any given direction diminishes with increasing protein content. Large elastic anisotropy in the plane of the shell of *M. Margaratifera* is indicated by the values $9 \cdot 3 \times 10^{11}$ dynes/cm.^{2} and $5 \cdot 8 \times 10^{11}$ dynes/cm.^{2} for Young's modulus, parallel and normal respectively to the lines of growth. Elastic properties show more or less regular variation with direction in the case of shells of the Lamillibranchs and irregular variation in the case of the Gastropods. This corresponds to the orientation of the crystallites in the former group and to the absence of orientation in the latter. Within the same zoological group big variations of elasticity are found. A general expression is derived for calculating the elastic modulus of a compound structure in terms of the elastic moduli of component materials and their distribution. An example of the application of this formula is given. J. I.

3360. Compression Effects and Recrystallisation in Zinc Single Crystals. M. Śmialowski. *Zeits. f. Metallkunde,* 29. *pp.* 199–202, *June,* 1937.—Single crystals of Zn, produced as previously described [see Abstract 2346 (1937)], are cut into cubes parallel to the faces (0001), $(10\bar{1}0)$ and $(11\bar{2}0)$. The author then examines the effect of compressing the cubes perpendicular to the above faces. Because of twin-formation the compressed along the direction [0001] show the greatest proportional cubes deformation, and above a load of 5 kg./mm.^{2} the compression strength increases considerably, more so than in the case of the other directions. The presence of bent glide lamellæ is established in the case of the crystals compressed along the directions $[10\bar{1}0]$ and $[11\bar{2}0]$. In crystals compressed along [0001] recrystallisation takes place proportionally over the whole cross-section. Annealing at temperatures from 260° C. to 280° C. leads to large grain size. The influence of impurities on the velocity of recrystallisation is discussed. J. I.

3361. Velocities of Propagation of Elastic Waves in Crystals. E. Goens. *Ann. d. Physik*, 29. 3–4. *pp.* 279–285, *June*, 1937.—For the accurate calculation of the specific heat of a crystal according to the theory of Debye and Born-Kármán a full knowledge is necessary of the spatial dependence on direction of the velocities of propagation for the three possible elastic wave-types in the crystal, one of these being longitudinal and two transversal. The theory relative to this has already been given by Christoffel. It leads to an equation of the third degree whose coefficients depend on the direction of propagation and the principal elastic constants, and whose three real positive roots are proportional to the three directions of propagation. The numerical calculation of the velocity of propagation for the complete spatial sphere (first undertaken by Grüneisen) has been continued by various authors, but the development of these calculations is somewhat difficult since the cubic equation for each direction of propagation has to be solved with new calculation of coefficients. Calculation of the velocity of propagation in quartz has shown that under certain conditions simplification is possible and the present paper develops a further special case of such simplification for the class of crystals of high symmetry. J. J. S.

3362. Formation and Mobility of Colour Centres in Alkali-Halide Crystals. H. Rögener. *Ann. d. Physik*, 29. 5. *pp.* 386–393, *July*, 1937.—For the investigation of electron conduction and photochemical processes in alkali-halide crystals the colour "centres" play a decisive part. They can be produced in a thermal way by heating the crystal in vapour of alkali metal. Mollwo's measurements exhibit the store of unvaporised alkali metal not ouside but inside the crystal, and in the form of colloidal particles visible in the ultra-microscope. In this paper a method of carrying-out these measurements in a simplified manner is described. The number of the colour centres was measured optically as by Mollwo. Now it is possible to colour homogeneously large pieces of crystal with a previously determined concentration ($10^{16} - 3 \times 10^{18}$ cm.$^{-3}$). Such crystals were used to show the influence of the concentration of the colour centres on their mobility in the electric field. (1) It was found that with constant temperature of the crystal the concentration of the colour centres in KBr and KCl crystals is very generally proportional to the concentration of the metallic atoms in the outer space. The factor of proportionality falls with rising crystal temperature. (2) The electrical mobility of the colour centres in KCl crystals is at high temperatures (670°) almost independent of their concentration, at low temperatures (under 550°) there occurs a slight influence of the concentration on the mobility. J. J. S.

3363. Electron Relay Conduction and Halogen Excess in Alkali-Halide Crystals. E. Mollwo. *Ann. d. Physik*, 29. 5. *pp.* 394–406, *July*, 1937.—Electron conduction in crystals of alkali halides can be produced by a stoichiometric excess not only of alkali metal, but also of halogen. In this case also the advance of the electrons can be optically traced. This has been previously shown for KI crystals, and the present paper widens the research. (1) The absorption spectrum of stoichiometric excess halogen was traced in KI and KBr. In KCl a halogen excess was not observed either optically or electrically. (2) In KBr and KI the halogen excess is found to be proportional at various temperatures to the vapour pressure of the halogen in the outer region. (3) The mobility of the halogen in the electric field is always smaller than that of the colour centres at the same temperature, and inversely proportional to the square root of the halogen concentration. This is explained as being due to molecular dissociation. (4) With fixed concentration the mobility rises as in the colour centres with rising temperature. (5) The thermal diffusion of the halogen is determined by observation of a tempering process in KCl and KBr crystals. (6) The thermal diffusion number D is always greater than that calculated from the electrical mobility. (7) A simultaneous diffusion of atoms and molecules is inferred. At high pressures the molecular diffusion preponderates. The number of particles passing through the cross-section with the same external pressure increases strongly with rising temperature. J. J. S.

3364. Diffusion and Reaction of Hydrogen in KBr Crystals. R. Hilsch. *Ann. d. Physik*, 29. 5. *pp.* 407–420, *July*, 1937.—The solubility of H_2 in the KBr lattice was determined for the temperatures 520°, 600°, and 680° C. In the reaction $2\ K + H_2 = 2\ KH$ the law of mass action also holds. The equilibrium constant for 680° was measured. Hence the degree of dissociation dependent on the concentration was calculated for the mixed crystal KBr + KH. The diffusion of the KH molecule in the crystal is measured for an exit concentration of $1 \cdot 2 \times 10^{17}$ mol./cm.^{3}. The mechanism of this diffusion is explained. The successive steps of the formation of hydride in the crystal indicates a migration of H_2 molecules in the lattice. The diffusion constant of the H_2 is practically just as great as that of the colour centres. That is to be considered in researches on photoelectric electron conduction in the crystals. J. J. S.

***3365. Measurement and Interpretation of Fibre Diffraction Patterns. George L. Clark and A. F. Smith.** *Rev. Sci. Instruments*, 8. *pp.* 199–201, *June*, 1937.—A description is given of a simple instrument which enables the radii, angular distribution and extent of the arcs of fibre diagrams to be measured. Another machine is described by means of which the most probable unit cell can be determined for any but the triclinic system. A system of rods is adjusted to represent the unit cell, it being assumed that the most prominent diffractions are due to the most important lattice planes. The spacings corresponding to other diffractions can then be determined by suitable adjustments, and a method of trial and error is resorted to in order to determine the best fit. An example of use is given and it is claimed that with good machining of the instrument parts the spacings are correct to ± 0·05 Å for most planes. A. G. Q.

See also Abstracts 3425, 3632, 3637, 3641, 3647, 3653, 3712, 3719, 3723, 3732, 3733, 3736, 3748, 3750.

DENSITY.

3366. Density of Molten Alumina. H. v. Wartenberg, G. Wehner and E. Saran. *Göttingen Nachrichten, Fachgruppe II.* 2. 5. *pp.* 73–75, 1936.—The tracks of falling drops of molten Al_2O_3 were photographed, and the volumes of the drops were calculated on the assumption that the drops were spherical. The density of the molten Al_2O_3 was derived from the determined volumes and the masses of the individual drops. Nine results varied from 2·34 to 2·73 gm./cm^3. with a mean of 2·54 gm./cm^3. P. H. B.

3367. Densities and Vapour Pressures of Alkylbenzenes, Aliphatic Ketones and *n*-Amyl Chloride. J. C. Rintelen, Jr., J. H. Saylor and P. M. Gross. *Am. Chem. Soc., J.* 59. *pp.* 1129–1130, *June*, 1937.—The vapour pressures of ethylbenzene, *o*-xylene, *m*-xylene, *p*-xylene, *n*-amyl chloride, methyl isopropyl ketone, methyl isobutyl ketone, diethyl ketone, dipropyl ketone and dibutyl ketone have been determined at 10, 30 and 50°. The densities of *n*-amyl chloride, methyl isopropyl ketone, methyl butyl ketone, methyl isobutyl ketone and dibutyl ketone have been determined at 10, 30 and 50°. AUTHORS.

***3368. Microdetermination of Density by Falling-Drop Method. S. Hochberg and V. K. La Mer.** *Indust. and Engin. Chem.* (*Analytical Edition*), 9. *pp.* 291–292, *June* 15, 1937.—A simple apparatus and technique are described with which the density of water solutions may be measured rapidly to ± 0·00001, using for each determination 2 drops of solution each containing 0·001 to 0·01 cc. For heavy water this corresponds to an accuracy of ± 0·01% calculated as D_2O. AUTHORS.

3369. Technical Powder Measurements. H. W. Gonell. *A.T.M. No.* 70. *T*47, *April*, 1937.—Standard methods are described for determining the specific gravity of the particles of a powder and the effective value of specific gravity, (i) after standardised delivery into a container, (ii) after settling by prolonged shaking, (iii) after centrifuging; a method is also given for finding the limiting surface inclination of a heap of powder before slipping occurs (angle of repose). L. V. C.

***3370. Gas Density Balance. N. R. Trenner.** *Am. Chem. Soc., J.* 59. *pp.* 1391–1395, *July*, 1937.—A simple type of quartz fibre suspended gas density balance which can be constructed easily is described. The method of adjustment and use of this gas balance as well as its characteristics are described and illustrated by experimental results. The use of this gas balance as an analytical device and as a primary standard for (making up) samples of the H isotopes of known D concentration is illustrated. AUTHOR.

See also Abstracts 3330, 3371.

DIFFUSION AND OSMOSIS.

3371. Pore Structure and the Specific Volume of Amorphous and Crystalline Substances. G. Graue and N. Riehl. *Naturwiss.* 25. *pp.* 423–425, *June* 25, 1937.—It is pointed out that the pore structure of a solid can vary and reference is made to the zinc sulphides which are examined by the new method based on the emanation from radioactive material introduced into the porous substance undergoing examination. J. K.

3372. Diffusion Constant of an Electrolyte. A. R. Gordon. *J. Chem. Phys.* 5. *pp.* 522–526, *July*, 1937.—A semi-empirical equation is proposed which predicts for KCl, NaCl and KNO_3 in aqueous solution, differential diffusion constants which agree with the experimentally determined values for the three salts within the limits of error of the experiments. The relation of the effective diffusion constant determined in the Northrop-McBain diaphragm cell to the differential diffusion constant is discussed; it is shown that Cole and Gordon's rule [see Abstract 4500 (1936)] that the effective diffusion constant measured in such a cell is equal to the differential diffusion constant for the mean concentration, is still a valid approximation even when there is a non-linear dependence of diffusion constant on concentration, provided the total concentration range involved is less than 0·1 *N*. AUTHOR.

3373. Diffusion of Heterodisperse Substances. I. Sakurada and M. Taniguchi. *Zeits. f. phys. Chem.* 179. *Abt. A.* 3. *pp.* 227–234, 1937.—A diffusion equation based on Fick's law is derived and the conclusion reached that the tables of Stefan and Kawalki are applicable to heterodisperse systems provided that the diffusion coefficient D of the latter is defined by $D = 100^2/(\sum_{i=1}^{i=n} c_i/\sqrt{D_i})^2$ where $c_1 + c_2 + \ldots + c_n = 100$ and c_i, D_i are percentage concentration and diffusion coefficient respectively of the *i*-th component. The equation is shown to apply closely to mixtures of glucose penta-acetate, cellobiose octa-acetate, hydroquinone, cellulose dextrine-acetate and acetylcellulose, examined by Oeholm's method. L. V. C.

3374. Diasolysis. H. Brintzinger and H. Beier. *Kolloid Zeits.* 79. *pp.* 324–331, *June*, 1937.—It has been established that a series of substances such as aniline, the three isomeric nitrophenols, the isomeric nitranilines, etc. are able to dissolve through solvent membranes such as caoutchouc, rubber, etc, while the latter are completely impermeable for a large number of other substances such as salts and pronounced hydrophilic compounds such as sugar and glycerin. The process of the penetration of a substance through a solvent membrane is termed diasolysis. Diasolysis obeys certain fundamental laws like dialysis, but differs from the latter in that it is possible only for a definite species of compound, *e.g.*, of pronounced organophilic substances, and does not occur with every molecular or ionic dispersed compound. The diasolysis method affords a practical preparative method for the separation of substances which can be diasolysed from those which are not diasolysable. Full experimental details are included. H. H. Ho.

See also Abstracts 3364, 3435, 3649.

ELASTICITY AND PLASTICITY.

3375. General Proof of de Saint-Venant's Principle. O. Zanaboni. *Accad. Lincei, Atti,* 25. *pp.* 117–121, *Feb.* 7, 1937.—The principle of de Saint-Venant on the equivalence, as regards elastic effects of systems of superficial forces having identical statical characteristics, is usually stated without proof. The present paper gives a general proof of the principle. A. J. McC.

3376. Problems of Plane Elasticity with Airy's Polydromic Function. C. Tolotti. *Accad. Lincei, Atti,* 25. *pp.* 226–230, *March* 7, 1937.—It is well-known that problems on plane elastic systems, which are acted on only by boundary forces, can be solved by a function *F*, first introduced by Airy, which satisfies the biharmonic equation $\nabla^4 F = 0$. When the system is multiply-connected, the function *F* must be many-valued. The present paper shows that such a problem can always be reduced to an analogous problem in which the Airy function is certainly one-valued and hence simplifies the solution. A. J. McC.

3377. Relaxation Methods Applied to Engineering Problems. Part I. Deflection of Beams Under Transverse Loading. K. N. E. Bradfield and R. V. Southwell. *Roy. Soc., Proc.* 161*A*. *pp.* 155–181, *July* 15, 1937.—The power of relaxation methods has been demonstrated in relation to frameworks and continuous beams, but their scope is at present restricted to members having uniform flexural rigidity, for the reason that orthodox methods are not able to provide general solutions of the problems considered in this paper. Here, with the object of removing the restriction, two numerical methods are developed; they are quite general, and their accuracy as applied to a particular example gives promise of their being capable (possibly after slight modification) of solving more complex problems—*e.g.*, beams subjected to transverse and end loading in combination, the critical loads of struts, the natural frequencies of airscrew vibrations, etc. These problems it is intended to treat in subsequent papers. AUTHORS.

3378. **Elastic Stability of a Thin Twisted Strip. Part II. A. E. Green.** *Roy. Soc., Proc.* 161*A*. *pp.* 197–220, *July* 15, 1937.—The work of a previous paper [see Abstract 1975 (1936)] on the elastic stability of a thin twisted strip is corrected and extended to the consideration of the stability of the twisted strip when it is also subjected to a tension along its length. It is found that the strip becomes unstable at a definite value of the twist and that the instability is in the form of a number of loops superposed on the twisted strip in contrast to one loop in the case when no tension acts on the strip. The theory has been compared with experiment and satisfactorily good agreement between them is found. AUTHOR.

3379. **Stresses in Thin Semicircular and Semi-Elliptical Plates. Rotating about the Bounding Diameter. B. Sen.** *Zeits. f. angew. Math. u. Mechanik,* 17. *pp.* 181–183, *June,* 1937.—Analytical solutions of these problems are obtained. W. G. B.

*3380. **Plasticity Measurements at High Temperatures. H. K. Griffin and H. H. Storch.** *Indust. and Engin. Chem.* (*Analytical Edition*), 9. *pp.* 280–286, *June* 15, 1937.—An instrument for precise measurements of plasticity at high temperatures is described. Adequate apparatus is included for avoiding eccentric loading. Measurements made on Pittsburgh and Alma seam coals show that the truly plastic properties of these coals are very transient, the life period being of the order of 1 min. at 460° C. Measurements of deformations proportional to the load were obtained at 410° C. An analysis of these data indicates that the deformations are elastic rather than plastic in character. Measurements on the deformation of the solid plus oily bitumen (obtained by benzene extraction) of Pittsburgh seam coal at 120° C. show that this is a truly plastic material. AUTHORS.

*3381. **Mercury Manometer for 200 Atmospheres. J. R. Roebuck and W. Cram.** *Rev. Sci. Instruments,* 8. *pp.* 215–220, *June,* 1937. —This paper describes a multiple tube Hg manometer constructed in connection with a projected measurement of the mechanical equivalent of heat by the porous plug method. The principle adopted is similar to that used by K. Onnes and others. Nine steel Hg tubes alternate in series with 8 of toluene each about 17·5 m. long. The Hg tubes are connected to the adjacent toluene tubes by devices in which the position of the Hg-toluene interface is determined electrically and the first Hg column is furnished with T joints and valves at 6 ft. intervals for connections with a glass tube in which the position of the free Hg surface is determined. 98 % of the tubing is enclosed in iron pipes through which kerosene is circulated for temperature control. A determination of the vapour pressure of CO_2 at 0° C primarily carried out to test the manometer resulted in the value 2613·22 cm. of Hg at 0° C, $\rho = 13{\cdot}5955$, $g = 980{\cdot}665$. The observed pressures reduced to standard conditions agreed to ± 0·0029 %. with an average divergence from the mean of 0·0019 %. Improved consistency is hoped for during the winter when temperature conditions in the neighbourhood of the manometer are more stable. P. H. B.

*3382. **Manganin Resistance Pressure Gauge. L. H. Adams, R. W. Goranson and R. E. Gibson.** *Rev. Sci. Instruments,* 8. *pp.* 230–235, *July,* 1937.—It is shown that the pressure coefficient of a coil of wire depends on the size and construction of the coil as well as upon the composition of the wire. The linearity of the pressure-resistance relation also depends on the size and type of coil. The effect of winding, of heat treating, and of pressure seasoning on the resistance and pressure coefficient of various coils is determined, and measurements are made on the effect of temperature on the pressure coefficient of manganin. Convenient equations applicable to the "fixed bridge" method for measuring small resistance changes are presented. AUTHORS.

See also Abstracts 3566, 3608, 3663.

GRAVITATION.

***3383. Determination of the Absolute Acceleration Due to Gravity with Long Pendulums. A. A. Ivanoff.** *Bull. géodésique, No.* 52. *pp.* 481–492, *Oct.–Nov.–Dec.,* 1936.—Spheres of different materials sizes and weights were suspended from steel wires in a double-walled tube at constant temperature. Details of the apparatus used, the method of observation, and the corrections applied, are given. For the first series of observations, 1906–11 at Leningrad, the result obtained was $g = 981{\cdot}948 \pm 0{\cdot}011$ cm./sec^2. Since 1930 in a second series of tests greater refinements were introduced and new corrections applied to this and the earlier results. The corrected value of g for the first series and the later series now gives $g = 981{\cdot}928 \pm 0{\cdot}002$ cm./sec^2. R. S. R.

See also Abstracts 3417, 3469.

HYDRODYNAMICS AND AERODYNAMICS.

3384. Two-Dimensional Hydrodynamical Theory of Moving Aerofoils. Part I. Rosa M. Morris. *Roy. Soc., Proc.* 161*A. pp.* 406–419, *Aug.* 3, 1937.—In this paper a complete solution is given to the two-dimensional hydrodynamical problem of the motion in incompressible and inviscid fluid of a cylinder of a general type, which includes all those for which solutions are known, and also the most general type of cylinder which is used in the discussions of aerofoil theory. The potential and stream function of the fluid motion are determined, and thence the energy and forces exerted by the liquid on the cylinder. The latter are determined both by the Lagrange-Kirchhoff method and by direct integration of the pressure, the latter determination being rendered tractable by the discovery of generalised forms of the Blasius contour integral expressions applicable when the surfaces are in motion. The effect of variable circulation has been considered but the discussion of the effect of surfaces of discontinuity is postponed for a further note. AUTHOR.

3385. Current in the Presence of a Circular Arc, with an Excentric Source. G. Sestini. *Accad. Lincei, Atti,* 25. *pp.* 112–117, *Feb.* 7, 1937.—Considers the problem of the steady two-dimensional flow of a current against an obstacle in the shape of a circular arc, and with a source in the liquid, not necessarily coinciding with the centre of the circle. A. J. McC.

3386. Instability and Breaking Up of Ring of Liquid. K. Ariyama. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 366–368, *April,* 1937. *In English.*—When a small drop of ink is put into still water, it assumes the form of an oblate spheroid, then becomes ring-shaped and subsequently breaks up into small drops the number of which depends on the ratio of the radius of the ring (R) to that of its cross-section (a). R is measured directly, and a is found from the initial volume of the liquid which is 1 part by weight of stearic acid dissolved in 2,000 parts of bacol, a heavy mineral oil. In general, the number of drops was from 2 to 4 more than theory predicted. [See Abstract 60 (1937)]. G. E. A.

3387. Two-Dimensional Potential Theory. Part IV. Expression for Fluid Energy and its Application. Rosa M. Morris. *Phil. Mag.* 24. *pp.* 47–52, *July*, 1937.—In continuation of previous work [see Abstract 2943 (1937)], the author discusses the interpretation of the field energy in terms of the complex potential for the hydrodynamical cases of (1) an elliptic cylinder, (2) the general cylinder moving perpendicular to its length, for acyclic motion of the fluid about the cylinder. The case of cyclic motion is briefly discussed. J. S. G. T.

3388. Resistance of a Ship among Waves. T. H. Havelock. *Roy. Soc., Proc.* 161*A*. *pp.* 299–308, *Aug.* 3, 1937.—The wave resistance of a ship in still water can be calculated to a certain degree of approximation after making various assumptions. Similar calculations are now made for a ship among free surface waves of small height; the additional resistance, which may be negative, is considered as, to a similar degree of approximation, the horizontal resultant of the additional pressures due to the free surface waves. The cases considered are (i) when the waves are stationary relative to the model, free transverse waves moving at the same speed, and also the case of a model on the waves left by another model in advance and moving at the same speed, (ii) a model, not free to pitch, in transverse waves moving with the speed appropriate to their wave-length. It is shown that the additional horizontal forces may be of the same order as the wave resistance in still water even when the ratio of wave-height to wave-lengths has only a moderate value. The various cases are discussed in relation to available experimental results. [See also Abstract 3469 (1936)].

AUTHOR.

3389. Stationary Ripples and Waves. M. Bouasse. *Ann. de Physique*, 7. *pp.* 599–699, *May–June*, 1937.—Stationary ripples and waves generated by water and an obstacle in relative motion are discussed experimentally and theoretically. Reference is made to the work of Russell, Poncelet and Kelvin. The formula of Kelvin expressing the relation of velocity of propagation of the waves to their wave-length does not accord in all particulars with experimental results, and Kelvin's theory cannot be generally applied. Deficiencies of the theory are discussed. The author considers that an inert obstacle merely modifies the form of the liquid surface in its neighbourhood, and it is considered that the problem is to discover how this local deformation produces distant deformation. A detailed investigation of ripples and waves generated under various conditions is presented. J. S. G. T.

3390. Approximate Solution of the Boundary Layer Equations for a Flat Plate. W. G. L. Sutton. *Phil. Mag.* 23. *pp.* 1146–1152, *June*, 1937.—A generalisation is given of the Kármán-Pohlhausen method of obtaining an approximate solution of the laminar two-dimensional boundary-layer equations with no pressure gradient. A polynomial velocity distribution is assumed, which contains a second parameter λ as well as the boundary layer thickness δ. $[u/U = 1 - s^3 - \lambda(s^3 - s^4)$, $s = 1 - y/\delta]$. This distribution is substituted into two equations in order to determine δ and λ as functions of x. One equation is the Kármán-Pohlhausen momentum equation, obtained by integrating the equation of motion across the boundary layer. The second equation is obtained by multiplying the equation of motion by u and then integrating across the boundary layer. The results obtained are close to the exact solution.

S. G.

3391. Velocity-Distribution in a Liquid-into-Liquid Jet. E. N. da C. Andrade and L. C. Tsien. *Phys. Soc., Proc.* 49. *pp.* 381–390; *Disc.,* 391, *July* 1, 1937.—The distribution of velocity in a liquid-into-liquid jet, issuing from a cylindrical tube with a tapering approach, has been measured by photographing the traces made by suspended particles, with strong illumination and a determined exposure. The results have been compared with the theory for a jet issuing from a point in an infinite plane, and it is shown that, supposing the equivalent point source to be within the orifice, good agreement is found except in the immediate neighbourhood of the orifice. An expression has been derived connecting the distance of the equivalent point source from the orifice with the Reynolds number. This enables the loss of kinetic energy of the jet to be worked out.

AUTHORS.

3392. Fluid Friction in Roughened Pipes. C. F. Colebrook and C. M. White. *Roy. Soc., Proc.* 161 *A. pp.* 367–381, *Aug.* 3, 1937.—Nikuradse (*V.D.I. Forschungsheft,* No. 361. 1933), experimenting with flow through uniformly roughened pipes, found comparatively abrupt transition from "smooth" law at slow speeds to "rough" law at high speeds. Other experimenters using surfaces of the nature of cast iron, wrought iron or galvanised steel, have obtained results which can only be explained by a much more gradual transition between the two resistance laws. The present experiments show that with non-uniform roughness, transition is gradual, and in extreme cases so gradual that the whole working range lies within the transition zone. This closes the gap between Nikuradse's artificial roughnesses, and those normally found in pipes.

AUTHORS.

3393. Boundary Layer Profiles Made Visible by Wilson Photograph of α-Rays. M. Matukawa. *Imp. Acad. Tokyo, Proc.* 13. *pp.* 98–100, *April,* 1937. *In English.*—A new method is described by which the velocity distribution curves in the air flow around an aerofoil are photographed. Pt wires activated with Po are embedded in the aerofoil which moves past a window in the cloud-chamber, and the photograph is taken by the momentary illumination from an exploded W wire. The air flow is shown by the ionisation tracks emitted through the boundary layer of the moving object.

N. M. B.

See also Abstracts 3432, 3433, 3476, 3477, 3528.

KINETIC THEORY OF MATTER.

3394. Numerical Calculation of $\int_0^\infty x^m e^{-x} f(x)dx$. D. Burnett. *Cambridge Phil. Soc., Proc.* 33. *pp.* 359–362, *July,* 1937.—This type of integral ($m > 0$) is of frequent occurrence in problems in the kinetic theory of gases and particularly in viscosity calculations. The result now obtained is an extension of one given by Berger [*Nova Acta Upsaliensis* (3), 16 (1893)] and the discussion follows closely that given by Whittaker and Robinson (*The Calculus of Observations*) of the Gauss formula for approximate curvature. The novelty of the procedure lies in the use of Sonine polynomials which are peculiarly well suited for the discussion of this type of integral. The cases which are of importance in kinetic theory have $m = 2$, 3 and 4, and for these cases the computations are given. [See following Abstract.] H. H. Ho.

3395. Determination of Intermolecular Forces in Gases from their Viscosity. D. Burnett. *Cambridge Phil. Soc., Proc.* 33. *pp.* 363–370, *July*, 1937.—Chapman's method of determining the coefficient of a gas of spherically symmetrical molecules under ordinary conditions afforded the result: $\mu = (5/8\mathrm{I})\,(mkT/\pi)^{\frac{1}{2}}\,(1 + \epsilon)$, where m is the mass of a molecule of the gas, T is the absolute temperature, k is Boltzmann's constant $1 \cdot 372 \times 10^{-16}$ and ϵ is a small quantity which is neglected in this paper, while $\mathrm{I} = \int_0^\infty \int_0^\infty x^3\, e^{-x} \sin^2\chi\, dx\, p\, dp$ and $\chi = 2 \int_{r_0}^\infty dr/r\{(r^2/p^2) - 1 - (r^2/xkTp^2)\phi(r)\}^{\frac{1}{2}}$, $\phi(r)$ being the mutual potential energy of two molecules. The cases in which further progress has now been made are: (1) molecules which are elastic spheres of diameter σ, for which $\phi(r) = 0$, $r > \sigma$; $\phi(r) = \infty$, $r < \sigma$. (2) Similar molecules surrounded by small attractive fields. (3) Molecules repelling one another with a force $\mathrm{A}r^{-n}$, so that $\phi(r) = \mathrm{A}r^{-n+1}/(n - 1)$. (4) Similar molecules with an additional attractive force $\mathrm{B}r^{-s}$, for which the analysis is similar. Methods for carrying out the calculations are given and numerical values for argon are included. [See preceding Abstract.] H. H. Ho.

See also Abstracts 3432, 3433, 3551, 3703.

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 3370.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

3396. Empirical Laws Expressed as Series of Exponentials. P. Vernotte. *Comptes Rendus*, 204. *pp.* 1626–1628, *May* 31, 1937.—The author points out that a series of exponentials will give a more accurate representation of a set of observational data than will a polynomial. G. C. McV.

3397. Statistical Theory of Successive Occurrence and its Several Applications. Shih Yen-Han. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 487–502, *May*, 1937. *In English.*—As successive occurrences the author considers events which occur in an instant successively over a period of time. The types of time dependency considered are at random, periodic, consecutive and its opposite, repulsive. From their physical meanings their mathematical significance is defined and certain relations are established between them. This method is applied to the felt earthquakes in Wakayama showing that they occur at random, with a consecutive range of 6 hr. and a period near to $2\frac{1}{2}$ days. An approximate method is considered and its applications and essential properties determined. R. S. R.

3398. Distribution of the Mean of Fisher's t^2 for Samples from a Normal Population. P. V. K. Iyer. *Indian Acad. Sci., Proc.* 5A. *pp.* 528–531, *June*, 1937.—It is established that the average of a number of independent t^2's calculated on the basis of a common appropriate variance is equal to the ratio of two variances. By using this fact the distribution of the average of Fisher's t^2 for samples from a normal population is derived. In view of this finding some suggestions are put forward for determining the significance of the difference between the means of samples of different sizes. AUTHOR.

3399. Use of the Median in Tests of Significance. S. R. Savur. *Indian Acad. Sci., Proc.* 5*A*. *pp*. 564–576, *June*, 1937.—In this paper a new test of significance, called the म test, in which the median is used, is given. It is shown that this test is quite independent of the, to us unknown, frequency-distributions in the populations from which our samples are drawn. The application of this test is quite simple. Hence the test appears to be far better than those in use at present and which are based on some assumed frequency-distribution, generally normal distribution. The म test is applied to some illustrative examples and the results compared with those obtained after the application of the existing tests. [See also Abstract 2404 (1937).] AUTHOR.

3400. Tests for Randomness in a Series of Numerical Observations. W. O. Kermack and A. G. McKendrick. *Roy. Soc. Edinburgh, Proc.* 57. 3. *pp*. 228–240, 1937.—An expression is given for the probability that any *run* selected at random from a large series of unequal numbers arranged in random order contains 2, 3, 4, 5, etc., numbers, including the first and last. A similar expression is given for the chance that two consecutive runs (a *gap*) should contain, 3, 4, 5, etc., numbers. The average length of a run and of a gap are respectively 2½ and 4 with standard deviations of $\sqrt{3/5s_1}$ and $\sqrt{6/5s_2}$, where s_1 and s_2 are the numbers of consecutive runs and gaps from which the average is calculated. The results may be employed to assist in the decision as to whether any particular series is or is not a random one. Examples are given of the application of these new criteria to various random and non-random series.

AUTHORS.

3401. Rationalisation of Electrical Equations. E. Brylinski and G. Darrieus. *Soc. Franç. Élect., Bull.* 7. *pp*. 562–572, *May*, 1937.—The text is given of the discussion on L. Bouthillon's paper [see Abstract 502 (1937)]. E. Brylinski points out that modification of the notion of the intensity of magnetic field is a basic necessity in any rationalisation at present acceptable; this being effected, the other modifications should be reduced to a minimum. Attention is drawn to the importance of avoiding confusion in notation. One of the merits of Darrieus' proposal is its demonstration of the symmetry between electrical and magnetic phenomena. The remarks by G. Darrieus emphasise that rationalisation should extend not only to Maxwell's equations but also to the expressions for electrical and magnetic energy per unit volume. Reasons are given for regarding as unacceptable Sommerfeld's definition of magnetic mass. Difficulties arising in the tensorial expression of magnitudes are discussed.

R. E. N.

***3402. Photoelectric Fourier Analysis. G. v. Békésy.** *E.N.T.* 14. *pp*. 157–161, *May*, 1937.—For harmonic analysis the author uses a silhouette of the original curve, which is scanned with a photographic profile of a sine wave, the density of the transmitting part being graded. The light thus transmitted through a slit is received on a photronic cell connected to a reflecting galvanometer. The author discusses the difficulty in illuminating the surface of the given curve uniformly and other sources of error. An automatic recording arrangement is included in the equipment. L. E. C. H.

3403. Numerical or Mechanical Solution of Partial Differential Equations. D. R. Hartree and J. R. Womersley. *Roy. Soc., Proc.* 161*A*. *pp*. 353–366, *Aug*. 3, 1937.—The method here considered for evaluating the solutions of partial differential equations consists in approximating by use of finite intervals in one variable, and integrating exactly in the other variable, and later correcting for the leading term of the error introduced by the use of finite intervals. The method depends on the form of the boundary conditions which must be specified on an open, not a closed, boundary. The process of correction for the error introduced by the use of finite intervals is investigated, and it is shown that with certain forms of boundary conditions, including those which are most likely to arise in practical application, this process eliminates not only the leading term in the error, but the next term also, leaving a residual error of the order of the fourth power of the interval. The feasibility of the method and the order of magnitude of the error have been examined by a numerical application of the method to an equation which has a formal solution which can be evaluated easily; the results are very satisfactory. Solution of partial differential equations by this method appears to be a very suitable field for application of mechanical means of integrating differential equations, such as the differential analyser. AUTHORS.

See also Abstracts **3377, 3387, 3394, 3409, 3415, 3477, 3645, 3738, 3771.**

MECHANICS, CLASSICAL.

3404. Fundamental Principle of Classical Mechanics. E. Almansi. *Accad. Lincei, Atti,* 25. *pp.* 10–13, *Jan.* 3, 1937.—The author objects to the fundamental law of mechanics, $A = F/m$, where A is the acceleration, F the force and m the mass, on the ground that it assumes without precise specification frames of reference fixed with respect to the universe. He proposes to replace this law by the following assumptions: (i) the universe consists of a system of bodies extending to infinity; (ii) the radial velocity of any two stars does not exceed certain limits, relatively small (from which it follows that lines joining very distant stars have invariable directions with respect to one another); (iii) with respect to any reference frame having such invariable directions the law $A_1 - A_2 = F_1/m_1 - F_2/m_2$ holds between the accelerations and forces of any two particles of the universe. It is then shown that for an isolated system of finite particles the original law is true referred to an invariable reference system with origin at the baricentre of the particles. A. J. McC.

3405. Newtonian Motion of Any Two Masses. G. Arrighi. *Accad. Lincei, Atti,* 25. *pp.* 177–184, *Feb.* 21, 1937.—By introducing a "centre of formation" relative to each body, the author succeeds in writing in a simple form the equations of motion in the classical two-body problem, where the dimensions of the bodies cannot be neglected. These centres are not fixed in the bodies and the author discusses their relative motions. A. J. McC.

3406. Dynamics of Bow and Arrow. C. N. Hickman. *J. of Applied Physics,* 8. *pp.* 404–409, *June,* 1937.—On the assumptions that the bow is made up of a rigid middle section and two limbs, each of which is bent into a circular arc for all positions of the draw, that the inertia of the limbs can be taken into account by an equivalent mass at their tips, and that the inertia of the string is equivalent to a mass added to that of the arrow, the motion of the arrow while under propulsion is found. In a discussion of the results it is found that many of the empirical features of bow design have a rational explanation. W. G. B.

***3407. Projectile Velocity Determination. H. Teichmann.** *E.T.Z.* 58. *pp.* 627–628, *June* 10, 1937.—The spot of a kathode-ray oscillograph is photographed on a rotating drum on which milli-sec. from a tuning fork are also registered. The gas pressure acts on a plate of quartz built in the barrel, and the resulting charge, amplified by a thermionic electrometer, is applied to the deflecting plates of the oscillograph. The projectile earths the plates temporarily on issuing from the barrel, and permanently on passing through a Bensberg grid a few metres away. The record therefore yields the gas pressure, the time of passage through the barrel, and the initial velocity of the projectile. P. V.

MECHANICS, QUANTUM.

3408. Foundations and Applications of Statistical Metric. A. March. *Zeits. f. Physik,* 105. 9–10. *pp.* 620–632, 1937.—In continuation of his earlier work [see Abstract 1055 (1937)] the author now points out that a statistical interpretation of metric makes it unnecessary to regard the term in γ, which he introduced into the metric, as a correction term. By an application to quantum electrodynamics it is proved that it is essentially impossible to define the position of an electron within a sphere of radius γ. G. C. McV.

3409. Theory of Spinors. Y. Mûtô and K. Yano. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 413–435, *May,* 1937. *In French.*—A dozen theorems on spinors and on their relations to vectors are proved. G. C. McV.

3410. Green's Function of the Dirac Equation. J. Meixner. *Ann. d. Physik,* 29. 2. *pp.* 97–116, *May,* 1937.—The Green's function for Dirac's equations of the electron is defined and its properties studied. The theory is applied to the determination of the disturbance caused in an atom by a light wave. G. C. McV.

3411. Solution of Schrödinger's Equation. A. Datzeff. *Comptes Rendus,* 204. *pp.* 1616–1618, *May* 31, 1937.—It is pointed out that Schrödinger's equation in two dimensions is a differential equation which can be approximately replaced by a difference equation, replacing the continuous variables by two discrete suffixes. The question of solving this difference equation in practical cases is not discussed. R. P.

3412. Relativistic Wave Mechanics and the Interaction of Light and Matter. J. L. Destouches. *Comptes Rendus,* 204. *pp.* 1618–1620, *May* 31, 1937.—The recently reported expression for an operator for the interaction of two Dirac particles [see Abstract 2963 (1937)] is extended by the deduction of an expression for the interaction of a system of *n* Dirac particles, and the results are applied to the interaction of a photon (neutrino and antineutrino) and an electron. A new principle of superposition of interactions, equivalent to the classical principle of superposition of forces, is introduced. N. M. B.

3413. Variation Calculation of Eigenvalues. R. A. Newing. *Phil. Mag.* 24. *pp.* 114–127, *July,* 1937.—The variation calculation of the eigenvalues associated with a differential system provides an upper bound for the least eigenvalue. There is no indication of the error involved in the approximation. An estimate of the accuracy of the approximation may be obtained if a lower bound for the eigenvalue is also known. An expression for such a lower bound is established, and compared with an alternative expression due to D. H. Weinstein [see Abstract 4444 (1934)]. Illustrative calculations are given for two simple problems in wave mechanics. The bound set up in this paper is analogous to, but of wider application than, a result obtained by E. Trefftz for the eigenvalues associated with integral equations. AUTHOR.

3414. Interpretation of Spin in Corpuscular Mechanics. F. J. v. Wiśniewski. *Acta Physica Polonica,* 6. 1. *pp.* 40–43, 1937. *In French.*—Electron spin is conceived as a state of rotation of the electron devoid of energy; a brief mathematical theory leading to this conclusion is given. J. S. G. T.

3415. Method of Solving Differential Equations of Wave Mechanics. A Schuchowitzky and M. Olewsky. *Phys. Zeits. d. Sowjetunion,* 11. 5. *pp.* 498–512, 1937. *In English.*—A method is given for solving the Schrödinger equation which is intermediate between the numerical and the variational methods. The method consists in dividing the region into intervals and in approximating in the intervals to the integral with a function containing a number of parameters. Several of the parameters guarantee the continuity of the function and its derivative, while the rest minimise the integral, taken over the interval, $\int[H\psi - E\psi]^2 dT$. The method is developed for the characteristic value problem and extended to the case of many variables; the increasing computational difficulties not being comparable with those in the numerical method. As an example the case of the H atom is considered. It is shown that the method gives fairly rapid convergence necessitating only a few intervals. The method does not require complex integrations and gives an analytical approximation as in the case of the variational method. G. O. B.

See also Abstracts 3603, 3604, 3731, 3754.

RELATIVITY AND ETHER.

3416. Test Corpuscles in General Relativity. H. P. Robertson. *Edinburgh Math. Soc., Proc.* 5. *pp.* 63–81, *June,* 1937.—The transition from a "field" description of a distribution of matter or energy to a "corpuscular" description is studied for the case of general relativity. An exact definition of the limiting process by which the field quantities acquire singular values along the world-line of the corpuscle is given. The field quantities are assumed to satisfy conservation laws only. The result that the world-line of a material corpuscle must be a geodesic of the metric is proved. It is also shown that the path of a light-pulse is a null-geodesic along which the electromagnetic energy-tensor is moved by parallel displacement. Collision phenomena are also discussed. G. C. McV.

3417. Gravitational Force and Gauss's Theorem in General Relativity. J. L. Synge. *Edinburgh Math. Soc., Proc.* 5. *pp.* 93–102, *June,* 1937.—A definition of gravitational force between two particles with adjacent world-lines is given in terms of the displacement vector drawn perpendicular to one world-line to meet the other. On this basis, an infinitesimal form of Gauss's theorem in general relativity is built up. G. C. McV.

3418. Lorentz Equation of Motion in the New Electrodynamics. Part II. Z. Chraplywyj. *Acta Physica Polonica,* 6. 1. *pp.* 31–39, 1937. *In English.*—In a previous paper [see Abstract 1503 (1936)] it was shown that for an electron in a homogeneous electric field, the Lorentz law of motion follows from the field equations of the new electrodynamics introduced by Born and Infeld. The result obtained was valid only for the case $t = 0$; this restriction is now removed by applying a " postulate of unambiguity," according to which the singularity representing the electron coincides with the energy centre of the electron field. J. S. G. T.

3419. Mathematical Theory of a New Relativity. S. M. Sulaiman. *Indian Acad. Sci., Proc.* 6. *pp.* 269–288 *and* 348–366, *Nov.*, 1936.—The author continues the development of his theory of gravitation based on the assumption that gravitational effects are propagated with finite velocity in flat space-time. He finds that the deflection of light by the sun amounts to 2″·61, and also claims that the edge-effect is a result of this gravitational type of deflection. Proceeding to the theory of light, he assumes that light is corpuscular, each corpuscule being a binary system consisting of two components of equal and opposite charges rotating round each other. Some consequences of this hypothesis are pointed out. G. C. McV.

3420. Effect of Translational Component of the Earth's Rotation on a Charged Condenser. E. Fenner. *Ann. d. Physik*, 29. 3–4. *pp.* 332–348, *June*, 1937.—An arrangement is described for deciding if the earth's rotation has any influence on a charged condenser. A plate condenser of capacity C farads is mounted with its axis of rotation in the plane of the plate and at right angles to the direction of motion of the earth. The plates are arranged to make an angle of 45° with this direction (for maximum sensitivity). If the condenser is charged to a potential of U it contains $\frac{1}{2}CU^2$ units of e.s. energy and if it is moving with a velocity v relative to the ether a torsional moment of value $Nv^2/c^2 \sin 2\alpha$ (N = constant, $\sin 2\alpha = 1$) would be expected, for the e.m. impulse has a component perpendicular to the velocity and this would tend to bring the plates parallel to the direction of motion. A detailed description is given of the paparatus and of a long series of tests carried out with it. No torsional moment is observed which could not be attributed to experimental error. The sensitivity of the apparatus is greater than that used hitherto and the limit of accuracy is of the order of 100m./sec. H. J. H. S.

See also Abstracts 3439, 3457, 3731.

SOLUTION.

3421. Continuity of the Metastable State. A. van Hook. *J. Phys. Chem.* 41. *pp.* 593–596, *April*, 1937.—The temperature-dilatation curves for supersaturated solutions of potassium nitrate, ammonium oxalate, oxalic acid, calcium nitrate, acetamide, and urea show no non-uniformity at the saturation point. This uniformity is confirmed by the scanty data available in the literature. The principle of continuity of properties into the metastable state is generally valid. AUTHOR.

3422. Internal Solubility in Soap Micelles. A. S. C. Lawrence. *Faraday Soc., Trans.* 33. *pp.* 815–820, *July*, 1937.—Oils and oil-soluble substances are dissolved in the interior of soap micelles which consist of the hydrocarbon tails of the soap molecules and which therefore act as a hydrocarbon solvent. The oil thus attains an apparent solubility in water. There is a definite saturation value for the amount of oil taken up. This is much smaller than the smallest droplet of an emulsion and there is no continuity between the two systems. The amount of oil taken up is of the same order for a given soap irrespective of molecular weight. The amount of solid solutes internally dissolved is limited by their solubility in the paraffin-interior. Hartley has described experiments to show that this solubility is that in paraffin in bulk. AUTHOR.

3423. Liquid Film in Gas Absorption. Margaret H. Hutchinson and T. K. Sherwood. *Indust. and Engin. Chem.* 29. *pp.* 836–840, *July*, 1937.—The absorption rates of pure gases in water were studied in an investigation of the effect of solute gas on the absorption coefficient under conditions where the liquid film resistance was controlling. Absorption was effected in a glass flask, with the gas exposed above a stirred water surface. Runs were made with He, C_2H_2, N_2, O_2, CO_2, SO_2 and Cl_2. At high stirrer speeds k_L is approximately proportional to the 0·6 power of the speed. In this range the results for eight different gases at a constant stirring speed of 171 r.p.m. gave an average k_L of 3·2 with a maximum deviation of only about 20 %. Properties of the solute such as molecular weight, diffusivity, and solubility in water appear to have little effect on k_L, and it may be concluded that k_L is substantially independent of the nature of the solute gas. At low speeds and at rest the coefficients for the several gases studied were influenced by natural convection effects and were independent of stirrer speed. AUTHORS.

3424. Solubility of Barium Nitrate in Concentrated Nitric Acid. C. H. Greene. *Am. Chem. Soc., J.* 59. *pp.* 1186–1188, *July*, 1937.—The solubility of $Ba(NO_3)_2$ is measured at 0·00 and 24·88° in concentrations of nitric acid ranging up to 92 %. Equations are derived which express the logarithm of the solubility as a quadratic function of the per cent. of acid. AUTHOR.

See also Abstracts 3329, 3673.

SURFACE TENSION AND COHESION.

3425. Surface Tension of Molten Al_2O_3 and La_2O_3. H. v. Wartenberg, G. Wehner and E. Saran. *Göttingen Nachrichten, Fachgruppe II.* 2. 4. *pp.* 65–71, 1936.—The surface tensions of Al_2O_3 and La_2O_3 just above their melting points were determined by the drop weight method. For Al_2O_3 the mean of 14 values ranging from 502 to 678 dynes/cm. is 577 dynes/cm., and for La_2O_3 the mean of 9 values ranging from 522 to 595 dynes/cm. is 556 dynes/cm. These results form the basis of a discussion of the lattice of La_2O_3. P. H. B.

3426. Surface Tension of Heavy Water. T. Takéuchi, T. Sugita and T. Inai. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 552–554, *June*, 1937. *In English.*—The surface tension of heavy water is determined with a capillary U-tube placed in a thermostat, and the Eötvös formula is obtained. AUTHORS.

3427. Surface Tension of Water and Heavy Water. J. Timmermans and H. Bodson. *Comptes Rendus*, 204. *pp.* 1804–1807, *June* 14, 1937.—The surface tension of H_2O was determined between 0° C. and 40° C. by means of the capillary-rise, bubble-pressure, and drop-weight methods. The results obtained by the three methods agree within about 0·1 dyne/cm. The surface tension of D_2O (99·70%, 1·10526 gm./ml. at 20°C.) from Norway was investigated by the capillary-rise method only. For neither H_2O nor D_2O is the γ, T relation linear, but $d^2\gamma/dT^2 = 0$ for H_2O at 13° C. and for D_2O at 17° C. The mean association coefficients calculated over the interval 20° C. to 80° C. on the basis of surface tensions and Riesenfeld and Chang's critical temperature data are 3·0 for H_2O and 2·9 for D_2O. Taking into account the differences between the melting points and boiling points of the two waters it may be said that in this connection they behave similarly. P. H. B.

3428. Surface Tension of Deuterium Oxide and of its Mixtures with Water. G. Jones and W. A. Ray. *J. Chem. Phys.* 5. *pp.* 505–508, *July*, 1937.—The surface tension, σ, of $97\cdot8\%$ D_2O and of five more dilute mixtures with water has been compared with ordinary water by a modification of the capillary rise method. The results show that the relative surface tension is slightly less than that of pure water and is a linear function of the specific gravity. The data may be represented by the equation $\sigma = 1 - 0\cdot00501\Delta s$, where Δs is the increase in specific gravity over ordinary water. By a slight extrapolation the surface tension of pure D_2O at 25° C. is estimated to be $0\cdot99946$ of that of ordinary water at the same temperature. AUTHORS.

3429. Effect of Evaporation upon the Stability of Liquid Films. H. A. Neville and T. H. Hazlehurst, Jr. *J. Phys. Chem.* 41. *pp.* 545–551, *April*, 1937.—Liquid films thin by drainage and by suction, owing to surface tension where curvature exists. No static condition of equilibrium can be established. A film can persist only so long as flow of liquid into the thin portion counteracts drainage. The flow or pumping action into the thin region results from evaporation of the liquid. Uniform evaporation produces the greatest cooling where the film is thinnest, and warm liquid floods the colder areas with resultant decrease in surface energy. When evaporation is prevented by surrounding the film with its own saturated vapour, the temperature of the film becomes uniform and flow into the thin portion ceases, while drainage continues to decrease its thickness until rupture occurs. Condensation of other vapours upon the film, metallic conduction, or any other means which supplies heat to the thin portion of the film, tends to destroy the film. The dynamic equilibrium in liquid films can be studied by observing the remarkable display of changing interference colours in thinned films where the thickness at any point can be estimated from the reflected colour. AUTHORS.

3430. Wetting of Metals. B. Kabanov and N. Ivanishenko. *Acta Physicochimica*, 6. 5. *pp.* 701–718, 1937. *In English.*—A study, in connection with flotation, of the layer of electrolytic solution adsorbed at a Hg-gas bubble boundary. It is found that surface-active substances increase the wetting of a clean Hg surface, especially near the maximum of the electrocapillary curve. For solutions containing Na_2SO_4 and surface-active substances the interfacial tension σ_{13} of the Hg-bubble boundary is calculated for various values of the Hg potential ϕ from observed electrocapillary curves and surface tensions of solution-gas boundaries. An explanation of the shape of the σ_{13},ϕ curves is based on assumed changes in the thickness of the electrolytic layer at the Hg-bubble boundary. A relation established between the contact angle observed immediately after changing the polarisation and the change of the contact area is explained with the help of assumptions concerning the expansion of the electrolytic layer under the bubble, and is used in the calculation of the thickness of the layer. It is thus found that on increasing the kathodic polarisation the layer thickens rapidly at a potential of $-1\cdot5$ V. At $-1\cdot7$ V it reaches a thickness equal to that of hundreds of water molecules. P. H. B.

See also Abstracts 3386, 3423, 3664.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 3407.

VACUA, HIGH.

***3431. Quartz Manometer. J. Nikliborc.** *Acta Physica Polonica,* 6. 1. *pp.* 19–27, 1937. *In German.*—An improved form of the manometer previously described [see Abstract 108 (1936)] is given. It consists of a quartz fibre about 1/70 mm. thick to which is attached a polished quartz plate 20 × 24 × 0·2 mm. in size. Below this is fixed a capillary tube carrying a nickel wire. Torsional vibrations, about the quartz fibre as axis, are set up, and take place in a homogeneous magnetic field. The decrease in amplitude of these vibrations is measured either photographically or in a telescope. The pressure to be measured can then be deduced from this decrement. A convenient method of drawing the quartz fibres is also described. G. G.

See also Abstract 3679.

VISCOSITY, FRICTION AND LUBRICATION.

3432. Flow of Gaseous Mixtures through Capillaries. Part I. H. Adzumi. *Chem. Soc. Japan, Bull.* 12. *pp.* 199–226, *May,* 1937.—The viscosities of H_2, CH_4, C_2H_2, C_2H_6, C_3H_6 and C_3H_8, and of 7 binary mixtures formed therefrom, were determined at temperatures between 20° C. and 100° C. by the capillary flow method, air being used as standard. On choosing suitable values for C_{12}, the Sutherland constant related to the attraction between molecules of different gases, the determined viscosities of the binary mixtures are represented satisfactorily by Kuenen's formula. The theoretical consideration of C_{12} by Schmick and London is examined. Conditions are derived for the occurrence of maximum and minimum values for the viscosities of mixtures, and are found to be correct for 50 out of 55 mixtures dealt with. The occurrence of maxima can only be explained on the basis of the persistence of molecular velocity. The maxima are dependent on temperature. The addition of a gas A having a small mean free path to a gas B having a larger one usually results in an increase in the mean free path of A and a decrease in that of B. P. H. B.

3433. Flow of Gases through a Porous Wall. H. Adzumi. *Chem. Soc. Japan, Bull.* 12. *pp.* 304–312, *June,* 1937.—A formula for the flow of a gas through a porous plate is derived and it is found that the observed quantity of flow is satisfactorily expressed by this formula. The method of estimating the values of the mean radius and the number of pores of a porous plate is proposed. AUTHOR.

3434. Effect of Electric Fields on the Viscosity of Liquids. Part I. O. Kimura. *Chem. Soc. Japan, Bull.* 12. *pp.* 147–149, *April,* 1937. *In French.*—The viscosity of a 5% solution of stearic acid in benzene increases to a maximum as the strength of an electric field (perpendicular to the direction of flow) is raised. The maximum is definite, though by simple kinetic theory an indefinite rise in viscosity would be expected. L. V. C.

3435. Variations of Viscosity with Concentration in Binary Liquid Mixtures. H. Lemonde. *Comptes Rendus,* 204. *pp.* 1628–1630, *May* 31, 1937.—The formula $3\eta = nm\Omega[ad + 2\beta R^2/(d - 2R)]$ is extended to mixtures (n = number of molecules per unit volume, of mass m and velocity Ω, d = the distance between the centres of two molecules, the radius of the impenetrable portion of which is R), and thus explains the apparent abnormalities in the isotherms of D, η, and F.

A close relation is thence shown between viscosity and change in volume on mixture, and between R and association and dissociation; also that variations in D agree with the intermolecular forces (attraction and repulsion) as required by the kinetic theory. [See Abstract 1969 (1936).]
C. A. S.

3436. Temperature, Pressure and Volume Coefficients of Viscosity of Fluids. R. H. Ewell. *J. Chem. Phys.* 5. *pp.* 571–576, *July*, 1937.—Since $(\partial\eta/\partial T)_p$ and $(\partial\eta/\partial T)_v$ are both positive for dilute gases and both are negative for ordinary liquids, they must be zero at some intermediate density. From data in the literature it is shown that these two coefficients do not become zero at the same state of the fluid, but that the former becomes zero at lower densities than does the latter. On this basis any state of a fluid can be placed in one of six categories, or loci, which are characterised by the signs and relative magnitudes of the two viscosity temperature coefficients. By the use of general mathematical equations relating four variables, the signs of the viscosity pressure and viscosity volume coefficients are deduced for the six loci. It is shown that the fluidity and volume of a normal liquid are linearly related for volume changes up to about 10 %, as both properties are varied with the pressure at constant temperature, *i.e.*, that $(\partial\phi/\partial V)_T$ is a constant. This is analogous to Batchinski's relation, according to which $(\partial\phi/\partial V)_p$ is a constant. From data in the literature it is shown that $(\partial\phi/\partial V)_T$ is about $\frac{2}{3}$ to $\frac{3}{4}$ of $(\partial\phi/\partial V)_p$ in agreement with relations deduced in this paper.
AUTHOR.

3437. Viscosity–Temperature Relations. M. Souders, Jr. *Am. Chem. Soc., J.* 59. *pp.* 1252–1254, *July*, 1937.—The kinematic viscosity–temperature equation, $\log_{10}\eta/d = A/T - B$, is fitted to the data on 47 organic liquids with errors in most cases of less than 1 %. The constants A and B and the errors at various temperatures for each compound are reported. This equation appears to be at least as accurate as the equation of Andrade and is more convenient to use. The error increases with increase in molecular weight rather than with increase in viscosity. The equation is not suited for materials of high molecular weight such as petroleum oils.
AUTHOR.

***3438. New Method for Viscosity Determination. E. A. Zahn.** *Gen. El. Rev.* 40. *pp.* 285–286, *June*, 1937.—A new type of instrument for measuring viscosities of liquids such as paints, etc., where the control of such mixtures is most easily carried out by viscosity measurements. A number of cups of equal size are provided, each having a different sized aperture in its base. In use, these cups are kept in the liquid under test and when a test is required to be made the appropriate cup is lifted clear and a stop-watch started. On completion of the drainage the time is noted and the viscosity read from a table or curve, or the time can be used directly if relative readings only are required. It is desirable to choose an aperture such that the time of discharge is at least 20 sec. The temperature must be known, and kept constant for relative readings, otherwise corrections have to be applied as it has considerable bearing on the viscosity. The cup is shown in section and is dimensioned.
E. H. W. B.

See also Abstracts 3331, 3392, 3395, 3566.

ASTRONOMY AND ASTROPHYSICS.

COMETS AND METEORS.

See Abstract 3498.

COSMOGONY.

3439. Relativity Solution for the Expanding Universe. P. Udeschini. *Accad. Lincei, Atti,* 25. *pp.* 231–237, *March* 7, 1937.—The author adopts the following expression for the element of space-time: $ds^2 = V^2dt^2 - e^{f(t)}\,dl^2$, $V = c(1 - r^2/4R^2)(1 + r^2/4R^2)^{-1}$. This represents a generalisation of de Sitter's expression to which it reduces when $f(t) = 0$. Applying Einstein's gravitational equations and making certain approximations the author obtains for the displacement towards the red of spectrum lines emitted by matter at a distance r the result: $-\delta\nu/\nu = kr/2c + (k/4c^2 + 1/2R^2 + h/c^2)r^2$. The term in r^2 will be appreciable only for distances greater than 10^9 light years. Interpreted in the usual manner this would imply a velocity of recession of the extragalactic nebulæ varying with the distance according to a parabolic law of the above form. W. S. S.

3440. Infinite Universe and the Luminosity of the Night Sky. B. Fessenkoff. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 3. *pp.* 123–125, 1937. *In French.*—The author considers theoretically the contribution to the light of the night sky made by the total direct light of the stars, and by the light diffused by interstellar matter. The galaxy is considered as a flat, thin, infinitely extended layer filled uniformly with stars and diffusing material. Expressions are obtained for the amount of light due to these two causes received by an observer immersed in the layer. The conditions necessary for the approximately equal contributions observed on the earth are investigated. The amount of light due to the extragalactic nebulæ is also calculated. The expression obtained is proportional to the radius of the super-galaxy, which, since the night sky is not infinitely bright, must therefore be limited: its value should not exceed 20 times that at present observed. The author extends the treatment to systems of higher order, and investigates the physical meaning of the mathematical conditions imposed by the observed limited brightness of the sky on the dimensions of the consecutive systems of an infinite universe and on the absorption within such systems. A. Hu.

See also Abstracts 3444, 3445, 3447.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

See Abstracts 3405, 3458.

LATITUDE AND LONGITUDE.

3441. Astronomical Longitude and Azimuth Determinations. N. E. Nörlund. *Roy. Astron. Soc., M.N.* 97. *pp.* 489–506, *May*, 1937.—A survey is made of the methods of finding longitude and azimuth and of the sources of error which arise in the determinations of these quantities. The best methods of selection of the groups of stars for the clock correction in longitude determinations are described. The various errors in connection with azimuth determinations are also discussed, in particular, those due to errors in right ascension. A short description of the author's triangulations of Denmark and of Greenland is given. G. C. McV.

See also Abstract 3472.

NEBULÆ.

3442. Physical Processes in Gaseous Nebulæ. Part II. Theory of the Balmer Decrement. D. H. Menzel and J. G. Baker. *Astrophys. J.* 86. *pp.* 70–77, *July*, 1937.—An exact algebraic solution of the equations given in Part I [see Abstract 2998 (1937)] is carried out for the statistical equilibrium of an assembly of hydrogenic atoms. The exciting radiation is assumed to come only from beyond the limit of the Lyman series. Hence discrete states are filled only by capture from the continuum and by cascade from higher discrete states. The electrons are assumed to have a Maxwellian velocity distribution. The formula is given in terms of a quantity b_n, the ratio between the actual population of state n and the population under conditions of thermodynamic equilibrium. An asymptotic expression is given for b_n in the case of large quantum number, from which it is shown that b_n approaches unity as n becomes infinite. Numerical solutions are deferred until the next paper. AUTHORS.

3443. Emission Nebula near σ Scorpii. O. Struve. *McDonald Observat. Univ. of Texas, Contrib. No.* 5. *Astrophys. J.* 86. *pp.* 94–99, *July*, 1937.—With the use of a photographic emulsion sensitised for Hα, diffuse galactic nebulæ have been classified into three groups, depending upon the relative intensity of the red image to the violet image. This method is used to determine the character of nebular spectra. A nebula near σ Scorpii is found to be of the emission type. The red image does not, however, coincide exactly with the violet image. A part of the latter is therefore attributed to pure reflection. The spectrum of the star is B1. AUTHOR.

3444. Red-Shifts and the Distribution of Nebulæ. E. Hubble. *Roy. Astron. Soc., M.N.* 97. *pp.* 506–513, *May*, 1937.—The author replies to criticisms brought by Eddington and by McVittie against his interpretation of the counts of spiral nebulæ which leads to a small spherical universe. He discusses the probable errors in the formula for the dimming effect of the red-shift and concludes that they are small. McVittie's interpretation of the results, which leads to an infinite hyperbolic universe, is rejected because it disagrees with the spatial distribution of nebulæ found by Hubble, which is based on a certain definition of distance in terms of apparent photographic magnitude. G. C. McV.

3445. Effect of Red-Shift on Magnitudes of Nebulæ. W. Fricke. *Zeits. f. Astrophysik*, 14. 1. *pp.* 56–61, 1937.—The work of Eddington [see Abstract 1563 (1937)] is repeated rather more fully. It is confirmed that Hubble's nebulæ counts do not yield results accurate enough for the red-shift to be attributed with certainty either to recession or to some other cause. The observations therefore cannot distinguish between a stationary and an expanding universe. A. Hu.

3446. Frequency of Occurrence of Concentrations in Extra-Galactic Nebulæ. P. Bourgeois and J. Cox. *Comptes Rendus*, 204. *pp.* 1622–1623, *May* 31, 1937.—The authors discuss Hubble's discovery that the concentration frequency curve for nebulæ in extra-galactic space loses its asymmetry when plotted with logarithmic abscissæ. Thus if C is the most frequently occurring concentration, a concentration of Cn is as likely to occur as one of C/n, where n is any number. Hubble regards this as a property of the numbers rather than of the distribution of the nebulæ and interprets the asymmetry as a measure of the tendency of the nebulæ to assemble. It is pointed out, however, that the production of groups of nebulæ at the expense of a uniform distribution necessarily creates a relationship between the concentrations in adjoining fields. A given volume cannot enrich itself n-fold without, for example, n equal volumes being simultaneously impoverished n-fold elsewhere. A. Hu.

3447. Criterion for the Reality of the Velocities of the Nebulæ. A. Machiels. *Comptes Rendus*, 204. *pp.* 1708–1710, *June* 7, 1937.—Hubble has contended that, if the recession of the extra-galactic nebulæ is due to velocity, their luminosities must be diminished through two causes: (1) because the red-shift decreases the energy of their radiation, and (2) because it diminishes the rate of arrival of photons at the observer. The latter effect operates only in the case of a true velocity, so that the luminosity-correction has a special value in this case. The existence of such an effect is now criticised on the ground that it conflicts with the quantum theory of the photon. G. C. McV.

See also Abstract 3439.

PLANETS.

3448. Amount of Carbon Dioxide above Reflecting Layer in Atmosphere of Venus. A. Adel. *Astrophys. J.* 85. *pp.* 345–361, *June*, 1937.—Previous analysis has established the identity of the initial and final states of the three absorption bands photographed by W. S. Adams and T. Dunham, Jr., in the infra-red spectrum of Venus and traced by them to the molecule of CO_2. The present investigation concerns itself with the determination of the wave-functions of these states and the subsequent calculation of the transition intensities. These results are combined with the transition intensity of the fundamental absorption band ν_3, for which band the percentage absorption is known, approximately, as a function of the path length. It follows that an equivalent path length of approximately 400 m.-atm. of CO_2 is required to develop the absorption bands $5\nu_3$ and $5\nu_3 + \left(\begin{matrix}\nu_1\\2\nu_2\end{matrix}\right)$ as they appear in the spectrum of Venus. This estimate is probably low, in view of experiments performed by Dunham and by Adel and Slipher on the quantity of CO_2 required to duplicate the spectrum of Venus. However, because of the accuracy with which the constants entering the calculation are known, the computed result is probably better than the order of magnitude. AUTHOR.

See also Abstract 3480.

STARS.

3449. Stellar Luminosity and Photospheric Pressure. E. A. Milne. *Roy. Astron. Soc., M.N.* 97. *pp.* 513–531, *May*, 1937.—For a star of any structure, the pressure at the photosphere is calculated in terms of mass, photospheric molecular weight, effective temperature and a coefficient depending on the form of the internal relative density-distribution. The photospheric pressure is also calculated from the equilibrium of the extra-photospheric layers in terms of mass, luminosity, effective temperature and photospheric opacity. The equality of the two values of the pressure yields a formula independent of effective temperature connecting luminosity with mass. The coefficient in this formula is analysed into factors depending respectively on the photospheric compressibility and the internal compressibility. The photospheric compressibility can be approximately represented by a polytropic index $s = 3$. The resulting luminosity formula appears to represent the main features of the observed mass-luminosity correlation and gives the right order of magnitude for the luminosity. It is shown what inferences are possible about a stellar interior from observable data. The pressure in a stellar photosphere, for stars of similar internal structure, should vary as the fourth power of the effective temperature and inversely as the square of the mass, independent of photospheric opacity. Sundry applications of this result are made. AUTHOR.

3450. Astronomical Applications of Radiation Formulæ. P. Rossier. *Arch. des Sciences*, 19. *pp.* 71–102, *March–April*, 1937.—Calculation of the absolute colour index (visual *minus* bolometric magnitude) of a star depends on a knowledge both of the eye's sensitivity curve and of the star's spectral distribution curve. Russell's approximation, which assumes the sensitivity of the eye to be concentrated on one wavelength, is compared with Armellini's, which postulates a " colorimetric wave-number " independent of temperature. The hypotheses are shown to be equivalent, each being a particular case of the theory developed by the author [see Abstract 1583 (1935)]. Various empirical formulæ, due to Hertzsprung, to Fabry, and to Wensel and his collaborators, showing how the visual brightness of a black body varies with its temperature, are used to determine the temperatures of late-type giants of known apparent diameter, and to calculate their absolute colour indices. Though the formulæ are of different analytical form and have been extrapolated from laboratory to stellar temperatures, the numerical agreement between the results they afford is good. This is considered to enhance the value both of the results themselves and of the author's theory. A. Hu.

3451. Continuous Spectrum of Early-Type Stars. D. Barbier. *Zeits. f. Astrophysik*, 13. 5. *pp.* 351–357, 1937. *In French.*—Theoretical results, derived from the hypothesis of radiative equilibrium in stellar photospheres, are compared with recent spectrophotometric observations on the intensity of the continuous spectrum in early-type stars. The change of colour temperature predicted by the theory on passing from one side to the other of the discontinuity at the Balmer limit is not of the same sign as that observed in B- and A-type stars, in which the colour temperature is higher for shorter wave-lengths. The discrepancy cannot be explained as a result of inaccuracy in the absorption coefficient measurements. It is suggested that the hypothesis of local thermodynamical equilibrium in stellar photospheres may not correspond with the facts, and that the existence of a chromosphere cannot be neglected. A. Hu.

3452. Spectral Classification of Stars of Types A to K. W. W. Morgan. *Astrophys. J.* 85. *pp.* 380–397, *June*, 1937.—An interpretation of the absolute-magnitude–spectral-type diagram is made in terms of the physical parameters effective temperature and surface gravity. Stars belonging to the main sequence are shown to have the characteristic of approximately constant surface gravity, and the fundamental nature of the effective-temperature–surface-gravity diagram is pointed out. The advantages of a two-dimensional empirical spectral classification are discussed. A practical two-dimensional classification system is outlined which can be employed with small-scale spectrograms. The determination of absolute magnitude by the line-ratio method is shown to be feasible for stars of types F5 to K9, from spectrograms of considerably lower dispersion than has been used previously. AUTHOR.

3453. Boundary-Value Problem of the Theory of Stellar Absorption Lines. B. Strömgren. *Astrophys. J.* 86. *pp.* 1–27, *July,* 1937.—The problem of the theoretical calculation of intensities within absorption lines is considered. The case when the ratio of continuous absorption to continuous-plus-line absorption is variable through the atmosphere in such a way that the relative changes are not very large but are otherwise arbitrary is considered. For this case convenient formulæ for the calculation of absorption-line intensities in the integrated spectrum are derived. With the aid of the relations derived, the relative influence of the various layers of the atmosphere on the intensities within absorption lines are discussed. The relations are specialised for comparison with equations previously derived by Eddington and Unsöld. The accuracy and range of applicability of the procedure developed is discussed. AUTHOR.

3454. Spectrophotometric Investigation of δ Cephei. Part II. W. Becker and W. Strohmeier. *Zeits. f. Astrophysik,* 13. 5. *pp.* 317–332, 1937.—The results are communicated of the reduction of 29 grating photographs of ζ Geminorum taken with a mirror prism camera on ortho- and panchromatic plates. The intensity distribution of ζ Gem. relative to the comparison star δ Gem. can be represented in the region 635 to 380 mμ by two gradients which intersect at 480 mμ. The amplitude of the short wave gradient amounts to 0·71 and that of the long wave one to 0·49. Three monochromatic light curves are deduced for φ Gem. for the wavelengths 557, 478 and 410 mμ. Colour indices are derived from the observed relative gradients which when corrected on account of the depression of the energy curve in the ultra-violet give a colour index of $0\overset{\mathrm{m}}{.}29$ instead of $0\overset{\mathrm{m}}{.}42$. The visual and photographic light curves calculated on Planck's law from the observed colour temperature fluctuation give an amplitude 1·64 and 2·48 times larger respectively than the observed one. [See also Abstract 130 (1937).] J. E. K.

3455. Pressure in the Interior of a Star. S. Chandrasekhar. *Astrophys. J.* 85. *pp.* 372–379, *June,* 1937.—Certain integral theorems on the equilibrium of a star are proved. [See also Abstract 3536 (1936).] AUTHOR.

3456. Opacity in the Interior of a Star. S. Chandrasekhar. *Astrophys. J.* 86. *pp.* 78–83, *July,* 1937.—In this paper two integral theorems on the radiative equilibrium of a gaseous star are proved. AUTHOR.

3457. Equilibrium of Polytropes in Curved Space. Z. Kopal. *Zeits. f. Astrophysik,* 13. 5. *pp.* 347–350, 1937.—It is shown that polytropic condensations of given density of arbitrary mass and radius in an Einstein universe have an average density depending on their internal structure. Condensations of this type, whether of stellar or nebular size, have initial polytropic indices of about 0·5. G. C. McV.

3458. Clusters of Stars in Kinetic Equilibrium. H. Mineur. *Comptes Rendus,* 204. *pp.* 1620–1622, *May* 31, 1937.—It is shown that a star-cluster rotating with the galaxy may be replaced, so far as its gravitational field is concerned, by an ellipsoid of uniform density. By assuming statistical equilibrium amongst the constituent stars, it is deduced that the ellipsoid is one of revolution, that it is elongated in the direction of the centre of the galaxy, and that its density exceeds a lower limit of

0·5 sun per cubic parsec. It rotates as a whole in the same sense and with the same angular velocity as the galaxy, residual velocities of the constituent stars being distributed spherically with a dispersion of the order of 0·1 km./sec. A cluster, considered as a gas with stars as molecules, is therefore at a very low "temperature" compared with the rest of the Milky Way. The relatively short relaxation time calculated for a cluster suggests that galactic clusters are in fact in kinetic equilibrium. The theory gives a mean semi-axis minor of 2·5 parsecs, in good agreement with observation. A. Hu.

3459. Physical Attributes of Cepheid Variables. F. Beileke. *Zeits. f. Astrophysik*, 14. 1. *pp.* 1–55, 1937.—The various parameters defining the physical state of Cepheids are examined. From a study of stars of the δ Cephei and RR Lyræ type whose parallax or proper motion is known, the author derives a correction of $+ 0·25$ mag. to be applied to Shapley's zero-point on the luminosity-period curve. Due allowance is made for absorption in the galactic plane. It is pointed out that Cepheid spectra show the *c*-characteristic of sharp lines, and colour- and radiation-temperatures of *c*-stars of types F0 to M3 are calculated. Mean values of colour indices, colour- and radiation-temperatures, radii, masses, and densities of Cepheids are then tabulated as functions of the period. In each case, upper and lower limits, as well as probable values, are stated; and the results are given for 3 different zero-points on the luminosity-period curve. The variations in these quantities during the cycle are then discussed. A suitable alteration of radiation-temperature is found capable of producing the observed amplitude of the light-curve. Intensity variations in the H and Ca^+ lines show that both the temperature and the surface gravity of a Cepheid alter during the cycle; the significance of phase differences between these variations and the brightness variations is discussed. A. Hu.

3460. Variables in Kapteyn's Selected Areas 2–19. E. A. Baker. *Roy. Astron. Soc., M. N.* 97. *pp.* 541–546, *May*, 1937.

3461. Brightness Variations in ζ Aurigæ and ϵ Aurigæ. K. Walter. *Zeits. f. Astrophysik*, 14. 1. *pp.* 62–75, 1937.—Photometric observations of the eclipsing variable ζ Aur. were made on some 40 nights extending from July, 1934, to Jan., 1937 (*i.e.*, over a whole cycle), in 2 spectral regions, of effective wave-lengths 0·43 and $0·61\mu$. The 30 cm. refractor used was fitted with a grating, and 3 comparison stars were also photographed. A probable error of 0·02 mag. for a single magnitude determination is claimed for the photoelectric method of measurement employed. The brightness of the system alters at eclipse by 0·70 mag. in the blue and 0·095 mag. in the red region. A secondary peak between eclipses is explained by pure reflection of the light of the B8 component from the K5 giant: a Milne process of absorption, temperature rise, and re-emission as Planck radiation would not give a sufficient rise of brightness in the blue. Emission of the H and K lines at the time of maximum reflection is attributed to fluorescence excited by B8 radiation in the extended chromosphere of the K5 star. The possible existence of short-period ($\ll$ 1 day) fluctuations is discussed. In an appendix the author examines the results of similar photometric observations made at the same time on ϵ Aur. A. Hu.

3462. Possible Effect of Recent Increase in Brightness of γ Cassiopeiæ. W. W. Morgan. *Astrophys. J.* 86. *pp.* 100–101, *July*, 1937.—Attention is called to possible effects of the recent increase in brightness of γ Cassiopeiæ on the brightness of the two near-by diffuse nebulosities. **Author.**

3463. Evolution of Nova Herculis 1934. W. Grotrian. *Zeits. f. techn. Physik*, 18. 6. *pp.* 146–160, 1937.—The author gives a complete account of the physical processes occurring during the development of the Nova. The subjects discussed include the following: the star before its outburst; its light curve; the radial ejection of matter; the photospheric zone and its contraction; development of the various spectra; structure of absorption and emission lines; density and velocity of expansion of the ejected gaseous shells; forbidden O I and Fe II lines and their respective development; the April, 1935, fall of brightness; appearance of the nebular lines; comparison between the central star and a white dwarf; the phenomenon on Milne's theory; nebular stage of the Nova and the Zanstra theory of planetary nebulæ; the June, 1935, rise of brightness; duplicity of the nucleus; schematic structure in the nebular stage. Spectrograms taken during the various stages of development are reproduced. **A. Hu.**

3464. Rates of Development of Novæ. D. B. McLaughlin. *Astrophys. J.* 85. *pp.* 362–371, *June*, 1937.—Ann Arbor spectrograms and published data on the seven bright Novæ of the twentieth century furnish velocities of the principal spectra and the diffuse enhanced spectra and time intervals from maximum light to several distinctive spectroscopic phases of development. Those Novæ whose light faded slowly showed longer time intervals between spectroscopic phases and had lower absorption velocities. The magnitude drop from maximum to each spectroscopic phase is independent of the rate of development. The seven Novæ were averaged by reducing them to a uniform time scale, through the intermediary of the light-curve. For all absorption-line stages there is a linear relation between the time of development of any Nova and the time of development for the average of the seven. If t is the time of development and r the rate, defined by the relation $r = 1/t$, it is found empirically that $r \sim V_1^2$ and $r \sim V_2^{3/2}$, where V_1 and V_2 are the velocities of the principal and the diffuse enhanced spectra, respectively. For the first appearance of the nebular radiations the rates are different, and the relation between the rates and the velocities is $r_n \sim V_1^{3/2}$. Assuming that the state of the spectrum is determined by the density of ejected gases and the intensity of radiation from the central star, the exponents of V are of the expected order of magnitude. The similarity of Novæ, regardless of the rate of development, is emphasised. **Author.**

SUN.

3465. Visual Observations of Intensity of Dark Markings on the Sun, and of Prominences. R. v. d. R. Woolley and H. W. Newton. *Roy. Astron. Soc., M. N.* 97. *pp.* 531–541, *May*, 1937.—Visual photometric observations made during 1936 of the intensities of stable dark markings and prominences in Hα light are described. The observations have been carried out with auxiliary photometric apparatus attached to the Hale spectrohelioscope at Greenwich. Corrections to the contours of the line for finite resolving power and for heterochromatic light (scattered light) are introduced. The central intensity (corrected), of the dark markings is 0·02, and the brightness of the (stable) prominences is 0·12, the unit being the intensity of the centre of the disc in the case of prominences and the adjacent disc in the case of dark markings, in both cases in wave-lengths just outside Hα. In a discussion it is suggested that the hydrogen clouds forming quiescent prominences are not self luminous, but opaque, so that the prominences are seen in reflected light, in a manner similar to a common cloud. AUTHORS.

3466. Non-Uniform Rotation of the Sun and its Magnetic Field. V. C. A. Ferraro. *Roy. Astron. Soc., M.N.* 97. *pp.* 458–472, *April,* 1937.—The author considers the general problem of the non-uniform rotation of the sun in its own magnetic field, and particularly the relation of this problem to that of the radial limitation of the field. The motion of the neutral ionised gas of which the sun is assumed to be composed, in an axially symmetrical field tends to cause a separation of the ions and electrons; this tendency is opposed by the electrostatic field set up by the separation. It is shown that in general this polarisation should be accompanied by a flow of electric current in meridian planes. Such a flow of current is, however, unlikely since the mechanical forces to which it would give rise would destroy the non-uniformity of the rotation by a kind of viscous drag. The bearing of this result on the problem of the radial limitation of the field is discussed: it is suggested that the diminution of the field radially outwards is unlikely to be as rapid as has been previously supposed. A. Hu.

3467. International Cooperation in Continuous Observation of the Sun. L. d'Azambuja. *Comptes Rendus,* 204. *pp.* 1623–1625, *May* 31, 1937.—A preliminary account is given of the results of world-wide cooperation in making continuous observations on chromospheric eruptions by means of the spectrohelioscope. The I.A.U.'s quarterly *Bulletin for Character Figures of Solar Phenomena* has now a considerable circulation amongst geophysicists, and correlations with major terrestrial magnetic and electric phenomena are no longer likely to escape notice. The 18 months ending Dec., 1936, saw a renewal of solar activity, and an average of 1·4 eruptions per day was reported. They are usually accompanied by an increase of brightness in their associated faculæ just as a spot appears. Their transience suggests that they play no part in periodic terrestrial phenomena associated with the sun's rotation. An eruption anywhere on the disc is frequently followed on the earth, within 30 min., by abrupt short-wave radio fading, by long-wave enhancement, and by feeble magnetic disturbances. It is therefore suggested that an eruption is accompanied by electromagnetic radiation which modifies in some way the earth's ionosphere. A. Hu.

See also Abstracts 3504, 3767, 3776.

ZODIACAL LIGHT AND GEGENSCHEIN.

3468. Annual Variation in the Intensity of the Zodiacal Light. C. T. Elvey. *McDonald Observat., Univ. of Texas, Contrib. No.* 4. *Astrophys. J.* 86. *pp.* 84–93, *July,* 1937.—The series of visual observations of the zodiacal light made by the Japanese observers has been reduced to a uniform system of intensities with the aid of photoelectric observations of the standard comparison areas in the Milky Way. Corrections were applied for differences in the zenith distance of the zodiacal light and the comparison field. Annual variations are shown to exist for both the evening and the morning zodiacal lights. The maximum for the evening light is near the middle of Jan., and that for the morning light is near the first of the preceding Nov. The suggestion is made that the enhancement of the zodiacal light at certain seasons of the year may be due to scattering by meteoric material associated with cometary orbits. [See also Abstract 2500 (1937)]. AUTHOR.

GEOPHYSICS.

GEODESY.

3469. Horizontal Pendulum and Changes of Level at Marburg. W. Schaffernicht. *Ann. d. Physik,* 29. 3–4. *pp.* 349–357, *June,* 1937.—Two horizontal pendulums of the Zöllner type were set up in the Marburg gravimeter cellar 15 m. deep. The pendulums registered respectively the component changes for azimuths 63·26° and 145·91°. Photographic curves show, as a result of high sensitivity, effects due almost entirely to solar and particularly to lunar forces. The observations are analysed, expressed in the form of equations, and compared with corresponding equations for a perfectly rigid earth. G. E. A.

See also Abstracts 3485, 3742.

GEOPHYSICS, APPLIED.

3470. Geophysical Prospecting with the Magnetometer. J. W. Joyce. *Bureau of Mines, Publ.* [129 *pp.*], *March,* 1937.—A treatise on the subject.

3471. Radioactive Prospecting. E. Rothé and Arlette Hée. *Comptes Rendus,* 204. *pp.* 1835–1837, *June* 14, 1937.—The radioactivity of various traps and granites at Raon l'Étape varies from 5·8*i* in a blue trap to 28·9 in a granite containing hæmatite and zircon. In general the radioactivity of the trap is considerably less than that of the granite, in which the highest values are associated with the presence of zircon (often exhibiting pleochroic haloes) and minerals containing rare earths. C. A. S.

3472. Distribution and Usefulness of the Laplace Points. C. F. Baeschlin. *Bull. géodésique, No.* 52. *pp.* 425–459, *Oct.–Nov.–Dec.,* 1936.—The theoretical basis employed for the points of Laplace in triangulation is first discussed in determining deviations of the vertical and the Laplace equation for a fundamental point. Their practical use is considered for (1) a chain composed of equilateral triangles, (2) astronomical observations, (3) relations between (1) and (2), (4) corrections of the Laplace equations for a triangulation, and (5) the distances between the points of Laplace. Finally conclusions are drawn regarding the use of Laplace points in triangulation, the azimuths and differences in longitude for the points and the astronomical elements, and rules are laid down for the determination of the distance of Laplace points and particularly for high latitudes. R. S. R.

HYDROSPHERE, PHYSICS OF THE.

3473. Tides. C. W. Oseen. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*A. No.* 24. [39 *pp.*], 1937. *In French.*—A mathematical paper on tidal theory. W. A. R.

3474. Water Transport of Gradient Currents. A. Jakhelln. *Geofysiske Publ.* 11. 11. [14 *pp.*], 1936. *In English.*—Reference is made to the assumptions in Helland-Hansen's formula to find the velocity at various depths and the water transport through a section. If, however, the average velocity component through a section between two stations is found the water transport can be determined directly. Further development of this procedure leads to a method for the computation of the water transport of gradient currents having advantages over Ekman's method and including Werenskiold's method. Using the latter the water transport of coastal currents can be found on certain assumptions by means of a single station. The theory underlying this development is given together with the errors involved. Examples are considered for charts showing the amount of current and for the flow between Spitzbergen and East Greenland. R. S. R.

LAND, PHYSICS OF THE.

3475. Geothermal Observations in Mines and Review of Results in Geothermics. J. G. Koenigsberger. *Beitr. z. angew. Geophys.* 7. 1. *pp.* 68–83, 1937.—Values of the geothermic gradient (M) range from 130 to 0·01 m./1° F. but are disturbed casually. Theoretically and in practice M $\propto$ K (thermal conductivity). The ratio is approximately true for undisturbed or only slightly disturbed regions, in loose sediments, flat lying sediments or with only slight anisotropy, older effusive rocks, palæozoic or older rocks and in saline eruptive rocks, for certain selected ranges of density. The causes of heating in other layers and cooling due to the sea are discussed. The lower temperatures observed in mines are due to cooling during the ice age, a strong efflux of water from above, or the high heat conductivity of the ore dykes. Ventilation of mines cools the rocks during decades of years. R. S. R.

3476. Flow of Fluids through Porous Media. M. Muskat. *J. of Applied Physics*, 8. *pp.* 274–282, *April*, 1937.—While no solution to this problem is at present possible by the systematic application of the Stokes-Navier equations, published experimental data show that for Reynolds numbers less than unity (*i.e.*, in the great majority of practical cases) Darcy's empirical equation $\mathbf{v} = -(k/\mu)\nabla p$ is closely applicable, v being the vector fluid velocity, p the fluid pressure, μ the viscosity of the fluid and k a constant characterising the porous medium. Particular solutions of this equation are considered for the various forms assumed by $\nabla^2 p$ in the cases of compressible and of incompressible liquids and of gases. The mass flux of a compressible liquid of average density $\bar{\gamma}$ is found to be the same as if the liquid were incompressible and of density $\bar{\gamma}$. Considerable attention is given to heterogeneous fluids of abnormally high compressibility such as occur in oil-fields owing to the dispersion of gas masses in the oil. The particular treatment is indicated and agreement with experiment indicated. [See also Abstract 5058 (1936).] L. V. C.

3477. Problem in Potential Theory. M. Muskat. *J. of Applied Physics*, 8. *pp.* 434–440, *June*, 1937.—The paper deals with methods of solving the following problem. A potential function has given values for all time on two surfaces S_1 and S_2. The space between S_1 and S_2 is divided into two portions by a movable surface $F(x, y, z, t) = 0$, which initially coincides with S_2. If n is the normal to F, and Φ_1, Φ_2 the potential functions between S_1 and F, and between F and S_2, respectively, then, on F, $\Phi_1 = \Phi_2$, $c_1 \partial\Phi_1/\partial n = c_2 \partial\Phi_2/\partial n$, where $\partial F/\partial t - c_1 \nabla\Phi_1 \cdot \nabla F = 0$, $\partial F/\partial t - c_2 \nabla\Phi_2 \cdot \nabla F = 0$, and c_1, c_2 are constants. The problem is solved by a "perturbation" method for $|c_1 - c_2|$ small, starting from the solution for $c_1 = c_2$; and also by a more general method of successive approximation. The problem arose in discussing the encroachment of water into an oil sand. [See also Abstract 4476 (1934).] S. G.

*3478. **Tidal Motions of the Earth's Crust. J. Egedal and J. E. Fjeldstad.** *Geofysiske Publ.* 11. 14. [30 *pp.*], 1937. *In English.*—The method adopted was the very accurate determination of changes of level of water at the ends of a horizontal tube partially filled therewith, 103·13 m. long, in a disused railway tunnel near Bergen. Observations continued from June 9–24, 1934. The level-variometers used, and the methods of calculation are described in great detail, but no definite conclusion as to the earth's rigidity is arrived at, as the effect of the varying tidal load in the adjacent ocean was of the same order of magnitude as the static tide caused by the direct action of the moon and sun, and no satisfactory means of separating them was found. The effect of the varying tidal load, however, was clearly shown. C. A. S.

See also Abstract 3471.

METEOROLOGY.

3479. Temperature Variation of Atmospheric Ozone. D. Barbier, D. Chalonge and É. Vassy. *Comptes Rendus,* 204. *pp.* 1665–1667, *May* 31, 1937.—In previous work [see Abstract 4921 (1935)] the authors were able to show a correlation between the ozone content and the origin of air masses. The object of the present investigation is to search for a relation between the temperature of ozone in the stratosphere and the origin of the air mass. The method of finding the coefficients of absorption for the region 3100 to 3300 Å has been described [see Abstract 1124 (1936)]. Comparison is then made between coefficients obtained with polar air and with subtropical air. As a result the authors find that the temperature at the centre of gravity of the ozone layer is higher for polar air than for subtropical. A. E. M. G.

3480. Lunar Eclipses and Distribution of Atmospheric Ozone. B. Fessenkoff. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 15. 3. *pp.* 119–121, 1937. *In French.*—The author considers first the luminosity of the earth's shadow arising from an element of the sun's surface at a distance ρ from its centre expressing this quantity as $f(\rho)$. Numerical values of $f(\rho)$ are obtained, and are seen to depend on the gradient of refraction. The influence of ozone is then considered, and a table gives a comparison between the values of $f(\rho)$, (*a*) including and (*b*) excluding the effect of ozone. When a summation is made of the effects of all the solar elements and a comparison carried out with photometric measurements of the observations of particular lunar eclipses it appears that ozone extends to nearly 30 km. Further measurements are considered desirable to elucidate the point. A. E. M. G.

3481. Correlation of Amount of Ozone with Other Characteristics of the Atmosphere. A. R. Meetham. *Roy. Meteorolog. Soc., J.* 63. *pp.* 289–305; *Disc.,* 305–307, *July,* 1937.—Day to day variations in the total amount of atmospheric ozone are shown to be more closely correlated with those of potential temperatures in the stratosphere than with those of any other function of temperature and pressure, or with those of any other geophysical phenomenon yet investigated. A method of correlating with a certain variable associated with surface pressure distribution is exploited, and of three upper air phenomena considered the height of the tropopause is found to have the closest correlation with this variable. A speculative explanation of the close connection of the amount of ozone with other characteristics of the atmosphere is offered. AUTHOR.

3482. Method of Predicting Night Minimum Temperatures. C. J. Boyden. *Roy. Meteorolog. Soc., J.* 63. *pp.* 383–389 ; *Disc.,* 389–392, *July,* 1937.—A simple general relationship, which appears to be applicable in any climate, is found connecting monthly mean values of maximum and minimum dry-bulb temperatures with mean wet-bulb temperatures. The formula is extended for predicting individual minimum temperatures on nights when there is no appreciable change of air-mass between the times of maximum and minimum temperature, allowance being made for wind speed, cloudiness and fog formation. AUTHOR.

3483. Winds in the Upper Troposphere and Lower Stratosphere over the United States. L. A. Stevens. *Monthly Weather Rev., Suppt. No.* 36. [29 *pp.*], 1937.

3484. Kinematical Features of Depressions. A. H. R. Goldie. *Meteorolog. Office, Geophys. Mem. No.* 72. [43 *pp.*], 1937.—The main object of the paper is to examine the kinematical features of some depression and some high-pressure systems. Two cases (a) the depression of Oct. 1–3, 1929, and (b) the depression of Oct. 7–9, 1930, are examined in detail, and the inferences drawn are tested by references to other cases. Among the average relationships arrived at in connection with a depression are the following :—(a) The average air motion is approximately that of a simple vortex except for a central area ; (b) In the polar air part of the central area there is sometimes direct proportionality of average speed to distance from centre ; (c) The central polar area increases in diameter with age of the depression. A more detailed analysis shows :—(a) A cell-like structure with convergence of air below the 2 km. level ; (b) A line of divergence lying in the warm area ; (c) A dual causation in the formation and development of depressions. Other points investigated are (a) the structure of wedges and the bearing of this on the formation of anticyclones, (b) the conception of the polar front as having the properties of a horizontal vortex line. The paper is illustrated by numerous diagrams. Various mathematical relationships are considered in four Appendices. A. E. M. G.

3485. Tides in the Atmosphere. S. Chapman. *Observatory,* 60. *pp.* 154–165, *June,* 1937.—Reference is made to the historical development of the observations of the lunar tide in the atmosphere. The amplitude and phase for 30 stations is shown on a map. The annual mean lunar tide varies from more than one hour after to nearly one hour before lunar transit and on the whole is nearly in phase with the moon. The amplitude decreases with increasing distance from the equator. There is a very marked annual variation, the maximum retardation in phase occurring at the December solstice in both hemispheres. The theory developed by the author, Taylor and Pekeris to explain the effects is outlined. R. S. R.

3486. Application of Wet-Bulb Potential Temperature to Air Mass Analysis. Part III. E. W. Hewson. *Roy. Meteorolog. Soc., J.* 63. *pp.* 323–334 ; *Disc.,* 334–337, *July,* 1937.—This paper describes a method of using the vertical wet-bulb potential temperature distribution in the warm sector of a depression to estimate the amount of precipitation which that depression will give at a later time. The actual results of applying this method to a number of depressions have been included. [For Part II see Abstract 1119 (1937).] AUTHOR.

3487. 27-Month Period in Rainfall. S. W. Visser. *K. Akad. Amsterdam, Proc.* 40. 6. *pp.* 513–517, 1937.—Seasonal totals of rainfall have been calculated, then averages and deviations therefrom deduced for the nine seasons of the 27-month period. Curves are obtained from these values. The curve for Western Europe shows a minimum in the 7th and 8th seasons. The stability of the 27-month period for the Netherlands is shown in a table covering the period 1849–1929. From the investigation the author is able to divide stations into 2 groups (a) those with a maximum about the 5th or 7th month, continental stations; (b) those where the maximum occurs during the 14th month or later, mainly oceanic. A second feature is retardation and decrease in amplitude on the Atlantic in the direction of the Gulf Stream. The minimum in Western Europe coincides with the maximum in N.E. Atlantic. The importance of these results for long-range forecasting is evident. A table gives the average values of the nine seasons' rainfall for several oceanic and continental stations.

A. E. M. G.

3488. Geometrical Theory of Haloes. Part III. E. W. Woolard. *Monthly Weather Rev.* 65. *pp.* 55–57, *Feb.*, 1937.—This section deals with reflection. After treating the cases of external and internal simple reflection the author considers the case of prismatic refraction accompanied by internal reflection from a principal plane. Thereafter prismatic refraction with internal reflection from any arbitrarily given plane is discussed. Formulæ are given by which the position of the image of the object may be found in each case, and diagrams illustrate the paths of the rays. [For Part II see Abstract 2497 (1937).]

A. E. M. G.

3489. Spectral Analysis of Auroral Luminescence. L. Vegard and L. Harang. *Geofysiske Publ.* 11. 15. [23 *pp.*], 1937. *In English.*—Long exposure spectrograms have been obtained in the infra-red and red regions, whilst interferometer measurements have also been made. The wave-length of the red auroral line is thus determined as 6300·30 Å, there being a slight discrepancy between the Oslo and Tromsø results. No trace of the red H or He lines is observed. Only some of the N_2 1st positive bands appear on the plates. This is due to the peculiar intensity distribution in the auroral spectrum, but the spectrum is very similar to that given by N_2 under the action of kathode rays. The wave-length of the green auroral line is determined as 5577·3445 (± 0·0027) Å, and within the limit of error this agrees with that for the O I line ($^1S_0$–$^1D_2$). Similarly, the red auroral lines 6300 and 6364 Å are shown to be the strongest components of the O I triplet ($^1D_2$–$^3P_{012}$). Full details are given of the work with the interferometer.

A. H.

3490. Auroral and Night-Sky Spectra. L. Vegard. *Zeits. f. Physik,* 106. 1–2. *pp.* 108–131, 1937.—Interferometer measurements confirm that the O lines ($^1S_0$–$^1D_2$) and ($^1D_2$–$^3P_{012}$) occur in the auroral and night-sky spectra, and that the red triplet is present both in sun-irradiated and red auroræ (type A), its relative intensity increasing with height. It is shown that sunlight cannot directly cause a change in intensity. The red 6300 line can occur with a much higher intensity than the 5577 green line, indicating that the $^1D_2$ state can be excited directly. The changes in intensity can be explained on the basis of excitation processes proposed for the O lines according to which the large effect on the red triplet arises from excitation of O_2 by activated N_2. The presence of bands of the ε-system both in auroral light and in that of the night sky shows that the A($^3\Sigma$) state of N_2 is present in high concentration.

C. B. A.

*3491. **Aerological Graph Paper. A. Refsdal.** *Geofysiske Publ.* 11. 13. [54 *pp.*], 1937. *In German.*—Since in Europe there will soon be 50 to 100 aerological ascents daily a simple and rapid method of working up is necessary. In different countries various forms of graph paper are used. The graph paper described is constructed to give simply and quickly in a graphical way the solenoidal calculation according to Bjerknes, the energy calculation according to Margules and Shaw, calculations of height, specific volume, equivalent temperature and entropy, the pseudo-temperature according to Stuve and the characteristic curve according to Rossby. The theory underlying these transformations is supplied. Finally examples are given of its use for purely theoretical problems involving corresponding pressure changes at the surface and high levels, the available energy in the atmosphere and mean temperature. R. S. R.

***3492. Light Mekapion. F. Lauscher.** *Zeits. f. Instrumentenk.* 57. *pp.* 245–249, *June*, 1937.—Experience obtained in the Vienna Observatory on the use of the light mekapion, an automatic photoelectric recording apparatus for daylight, is summarised in several notes dealing with the operating conditions, types of recorder, choice of light filter to correct the cell in accordance with the sensitivity of the eye. W. S. S.

***3493. Screen for Sheathed Thermometers. E. G. Bilham.** *Roy. Meteorolog. Soc., J.* 63. *pp.* 309–319; *Disc.*, 319–321, *July*, 1937.—After a brief survey of the history of the Stevenson thermometer screen, a new form is described in which the four sheathed thermometers, maximum, minimum, dry-bulb and wet-bulb, are all arranged approximately horizontally. This arrangement allows of a considerable reduction in the size and weight of the screen, and also has other advantages over the standard arrangement, in which the dry- and wet-bulb thermometers are placed vertically. AUTHOR.

See also Abstracts 3440, 3574, 3649, 3767, 3774.

SEISMOLOGY.

3494. Ellipticity Correction to Travel Times of P and S Waves. K. E. Bullen. *Roy. Astron. Soc., M.N. Geophys. Supplement*, 4. *pp.* 143–157. *May*, 1937.—The effect of the earth's ellipticity on the travel time of P and S waves is examined in detail. Tables are given for the correction for both kinds of wave for earthquakes of which the geocentric colatitude (α) of the epicentre (E) varies (at 10° intervals) from 30° to 90°, at observing stations (O) for which Δ varies similarly from 30° to 100°, and the azimuths (ϕ) of which relative to E vary by 30° intervals from 0 to 180°. The correction is also given for travel times for distances computed from geographic latitudes to those computed from geocentric latitudes. [See Abstract 2945 (1935), and following Abstract.] C. A. S.

3495. Suggested New "Seismological" Latitude. K. E. Bullen. *Roy. Astron. Soc., M.N. Geophys. Supplement*, 4. *pp.* 158–164, *May*, 1937.—The new "seismological" latitude, β, is defined as $\beta = 1\cdot 1\,\beta_1 - 0\cdot 1\beta_2$, where β_1 is the geocentric and β_2 the geographic latitude of the point concerned on the earth's surface. Its use facilitates the calculation of the ellipticity corrections [see preceding Abstract]. Illustrative tables are given. [See following Abstract.] C. A. S.

3496. Ellipticity Correction to P Table. H. Jeffreys. *Roy. Astron. Soc., M.N. Geophys. Supplement.* 4. *pp.* 165–184, *May*, 1937.—The above results [see two preceding Abstracts] are discussed in detail, and shown to be probably as nearly accurate as present knowledge allows. These results show the earth to be much more symmetrical, at least for continental epicentres than geological considerations would seem to imply. Further observations comparing travel times of continental and submarine earthquakes are specially desirable. C. A. S.

3497. Distribution of Deep-Focus Earthquakes. C. Davison. *Geolog. Mag.* 74. *pp.* 316–324, *July*, 1937.—Deep-focus earthquakes for the years 1918–31 are divided into the groups (1) 191 at depths 50–180 miles, (2) 79 at depths 205–380 miles. Their distribution is mainly along or near the Pacific margins and comprise two continental and three insular regions. Details are given for each area. The chief points of difference of the two sets of foci are (*a*) group (1) has a period of 14·8 days with an epoch near to new and full moon, (*b*) epicentres of ordinary and destructive earthquakes are numerous about the lines of group (1), and, except in the Philippines, rare along the lines for group (2), and (*c*) earthquakes in group (1) are about twice as frequent as those in group (2). For the S. America region fissures of three distinct ages appear which have different activities in affecting the coast line and thus conflict with the idea of continental drift. R. S. R

See also Abstracts 3397, 3469.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3498. Meteors and Upper Atmospheric Ionisation. J. N. Bhar. *Indian Journ. Phys.* 11. *pp.* 109–118, *May*, 1937.—The present work is an extension of the investigations on the effect of meteoric showers on the E-region of the ionosphere which were begun at Calcutta in 1933. In the previous work, on account of insufficient frequency range, the effect of meteors on the F-regions could not be studied. This has now been rectified and the present investigation has been made possible. Results of observations showed that the ionisation of the E_1- and E_2-regions increased enormously above its normal value during the Leonid meteoric shower of 1936—in the early hours of the mornings of Nov. 15 and 16. No appreciable change in the ionisation of the F_1- and F_2-regions occurred in these hours. There was an increase of F_1 ionisation at about midnight on Nov. 15, but this may be ascribed to a magnetic storm which was in progress during that night. The absence of any increase of ionisation of the F_1- and F_2-regions due to meteoric impact is explained after the Lindemann-Dobson theory of meteors [see Abstract 1069 (1923)].

AUTHOR.

3499. Distribution of Electricity in Thunderclouds. G. Simpson and F. J. Scrase. *Roy. Soc., Proc.* 161*A*. *pp.* 309–352, *Aug.* 3, 1937.—A method of obtaining records of the sign of the potential gradient at different heights in thunderclouds is described. The apparatus, which is carried by a sounding balloon, depends for its action on the fact that the potential gradient is often strong enough to cause a point-discharge current in a suitably exposed conductor; the direction of the current is recorded by a pole-finding device. The results show that, in general, a thundercloud has a positive charge in the upper layers, a negative charge in the lower part and very frequently a region of positive charge in the base. This lower region of positive charge is usually found in the neighbourhood of the active centre of a storm and is associated with heavy rain, which is nearly always positively charged. The region of separation of the upper positive charge and the negative charge occurs at levels where the temperature is well below freezing-point, and for this reason it is considered that the generation of the upper charge depends on the presence of ice crystals and not on the presence of water drops. The position of the lower positive charge supports the idea that it is generated by the "breaking-drop" process. AUTHORS.

3500. Diurnal Variations of Earth's Magnetism. M. Hasegawa and M. Ôta. *Imp. Acad. Tokyo, Proc.* 13. *pp.* 65–68, *March*, 1937.—*In English.*—Values are taken from the potential charts in a previous article [see Abstract 598 (1937)] for expansion in spherical harmonics. The external and internal coefficients of the main terms are tabulated, and the total effect of all the terms is shown in world maps of the equivalent external and internal current systems for the chosen epochs. The principal centre of circulation of the external current lies nearly at 30° N., whilst that of the internal current is at about 45° N. G. E. A.

3501. Zonal Components of Diurnal Variations of Earth's Magnetism. M. Hasegawa. *Imp. Acad. Tokyo, Proc.* 13. *pp.* 69–73, *March*, 1937. *In English.*—The mean integral values of X and Z components along circles of every 15° of latitude are calculated for two-hour intervals on IX, 23, and for every four hours on IX, 24, 1933, and the zonal residuals are graphed. The maximum errors appear to have occurred at 45° N. and 45° S. where their sums amount to more than 5 γ. Values of Z were determined from 60° N. to 60° S. in four cases, and the coefficients of the external and internal terms of zonal harmonics were calculated. From graphs of equivalent zonal currents certain features are found. The external and internal currents are generally in opposite sense. In the P-type variations, the currents flow so as to increase the X-force near the equator, but in the E-type variations, they increase it in the N. hemisphere and diminish it in the S. hemisphere. In the E-type variations there appears a considerable E–W current near the zone about 30°–40° N. The fairly large change of intensity of the zonal currents with latitude indicates that these currents take place on external and internal layers not very far from the earth's surface. G. E. A.

3502. Lunar-Diurnal Variation of Magnetic Declination. M. Bossolasco and J. Egedal. *Terr. Mag.* 42. *pp.* 123–126, *June*, 1937.—For the best representation of the field of the lunar-diurnal variation coordinates depending also on the magnetic elements of the place of observation should be used. Until now it has not been possible to compare theories on lunar-diurnal magnetic variation with the observations in a complete manner, because data have not been sufficient; in the future the data from Mogadiscio (and Pará) will make knowledge of the variation in question more complete. AUTHORS.

3503. Auroral Forms from Southern Norway. Part II. C. Størmer. *Geofysiske Publ.* 11. 12. [7 *pp.*], 1936. *In English.*—Photographs of bands with ray structure obtained during Jan. and March, 1936, are discussed. Of the aurora of 24th–25th Jan. sets of simultaneous photographs were obtained at two, three and four stations. Measurements of these are given in tabular form. The arc of March 24–25 was photographed from one station only (Trondheim). Assuming the height of this arc, the lengths of the rays and the distances between them have been calculated. Diagrams illustrate the geographical positions of the auroræ. A considerable number of the photographs are reproduced. [For Part I see Abstract 1577 (1936).] A. E. M. G.

3504. Origin of Aurora Particles. H. Alfvén. *Zeits. f. Physik*, 105. 9–10. *pp.* 633–641, 1937.—The geographical distribution of the aurora shows that the energy of the incident particles may go up to 10^8 eV. A mechanism for the emission from the sun of particles of this energy is suggested. It is shown that the magnetic field of the sun gives rise to an electric polarisation, causing the potential at the equator to be 2×10^8 V above that at the poles. If, but not unless, the magnetic field is disturbed, as in the neighbourhood of a sunspot, an electric discharge occurs, which is maintained on account of the sun's acting as a unipolar inductor. Particles of energy 10^8 eV are thus liberated, and find their way to the earth. It is suggested that a similar process operating in the stars may be the origin of cosmic radiation. D. H. F.

3505. Magnetic Field Produced by Lightning Discharges. H. Norinder. *Phys. Soc., Proc.* 49. *pp.* 364–375, *July* 1, 1937.—Measurements of the rapid variations in the magnetic field produced by lightning discharges are made by means of a frame aerial and a kathode-ray oscillograph. The observations make it possible under certain conditions to calculate the current-variations in lightning discharges, and maximal values up to 100 kA are derived. These are in good agreement with results obtained by other indirect methods. Conclusions as to the structure of the current-variations in lightning discharges are drawn from the measurements. AUTHOR.

3506. Earth-Current Variations with Periods Longer than One Day. W. J. Rooney. *Terr. Mag.* 42. *pp.* 165–172, *June*, 1937.—Examination of the earth-current records from Tucson and Huancayo shows that the daily mean values recorded on characteristically disturbed and calm days differ consistently by a small amount. This suggests that a part of the current flowing during disturbances or magnetic storms is unidirectional for the day or longer, and is the first definite indication of a component in earth-currents with period greater than one day. The magnitude of the effect is small, not more than a few per cent of the range of diurnal variation at a given station. The direction of flow indicated is to the N. and E. at Tucson and to the S. and E. at Huancayo. These directions are consistent with those noted in the diurnal variations but they may be modified by local geological features. The reversal of direction of the northward component is also a feature of the diurnal variations when the stations considered are on opposite sides of the equator. The potential gradient due to earth-current flow is so small at Watheroo, in proportion to the large and irregular contact-potentials occurring there, that the Watheroo records are not conclusive on this point. In so far as they have any significance, the results are in agreement with those at Huancayo and consistent with the preferred direction of current-flow found in the diurnal-variation records. A wider distribution of stations and a more accurate quantitative measure of the effect is necessary before attempting to suggest a system of current-circulation consistent with these results. AUTHOR.

3507. Lunar-Diurnal Variation in Earth-Currents. J. Egedal. *Terr. Mag.* 42. *pp.* 179–182, *June*, 1937.—It may be said that the existence of a lunar-diurnal variation in the earth-current potential-gradient is confirmed, and that in order to advance the study of this variation a closer examination of the observations and a comparison of results from different places are necessary. AUTHOR.

See also Abstracts 3467, 3775, 3776.

RADIOACTIVITY.

3508. Radioactive Isotope of Rubidium. A. Hemmendinger and W. R. Smythe. *Phys. Rev.* 51. *pp.* 1052–1053, *June* 15, 1937.—By means of a high intensity mass spectrometer the isotopes of rubidium have been separated. Measurements of the radioactivity of the isotopic samples indicate that Rb^{87} is radioactive and that there is no other isotope with an appreciable activity compared to Rb^{87}. AUTHORS.

3509. Materialisation of Energy of β-Rays of Thorium (B + C). M. Monadjémi. *Comptes Rendus*, 204. *pp.* 1560–1562, *May* 24, 1937.—Using Thibaud's method modified by increasing the gradient of the magnetic field (the too feeble character of which explains Benedetti's negative results [see Abstract 3336 (1936)]) with Al screens (to give varying thicknesses of Al to pass through) placed either near the source or far therefrom in the path of the positrons, and in one set of experiments a cellophane screen to absorb β-rays, the results, shown by curves in which numbers of positrons per min. are plotted against thicknesses passed through, indicate that the materialisation of β-rays is proportional to Z, that of γ-rays to Z^2. This confirms the results of Skobelzyn and Stepanowa, and da Silva [see Abstract 4120 (1936)]. C. A. S.

3510. Pair Production at β-Disintegrations. L. Tisza. *Phys. Zeits. d. Sowjetunion*, 11. 4. *pp.* 425–444, 1937. *In German.*—In a theoretical paper the probability of production of a positive and a negative electron at a β-disintegration has been calculated, treating the problem as one where the electron pair is produced by a Dirac spherical wave. The limiting cases of large and small β-energies have been dealt with. In the former case the energy distribution of the pair has been indicated. G. O. B.

3511. Theory of β-Disintegration and Nuclear Forces. Part II. G. Wentzel. *Zeits. f. Physik*, 105. 11–12. *pp.* 738–746, 1937.—Continuing previous work [see Abstract 603 (1937)], the shape of the continuous positron and electron spectra for light nuclei are deduced theoretically from considerations of exchange forces between spinless neutrons and protons. The method differs in principle from that of Fermi and of Konopinski and Uhlenbeck. In agreement with experiment, the results show less asymmetry for the positron than for the electron spectrum. F. C. C.

3512. Heavy Particle Interactions from β-Decay Theory. G. D. Camp. *Phys. Rev.* 51. *pp.* 1046–1048, *June* 15, 1937.—The small constant g of a Fermi type coupling is replaced by a function of the momenta of the light particles. A simple form of this function leads to a satisfactory phenomenological description of β-decay and proton-neutron interaction. The application of this function to the like-particle interactions, however, gives for them poorly defined ranges and magnitudes which are too small. The discrepancies seem to be intrinsic, so that this attempt to reconcile β-decay and heavy particle interactions has been abandoned. AUTHOR.

3513. γ-Radiation from Polonium-Beryllium. G. Occhialini. *Accad. Lincei, Atti*, 25. *pp.* 188–194, *Feb.* 21, 1937.—The energy of the γ-rays emitted by Be bombarded with Po α-particles is studied by a Wilson chamber method. Graphs are determined showing the frequency of occurrence of the Compton electrons as a function of their energy. From these it is deduced that the primary γ-radiation has an energy of 4 to 4·3 eMV but evidence of some rays of higher energy (greater than 5 eMV) was obtained. The experimental graphs show a deficiency of Compton electrons in the region 2·4 to 2·8 eMV consistent with the existence of a softer component of the rays of energy 2·7 eMV as obtained by Bothe by another method. W. S. S.

3514. Excitation of γ-Rays by Fast Neutrons. H. Aoki. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 369–385, *April,* 1937. *In English.*—Relative cross-sections of 41 elements for γ-ray excitation by neutrons of 2·4 eMV energy were determined. Plotted against the atomic number of elements, they distribute near a smooth curve which rises with atomic number in the region of lower atomic number and probably falls again at the heaviest stable elements. The energies of the γ-rays were determined in 11 elements by the method of coincidence of two thin-walled Geiger-Müller counters. The absorption curves of the secondary electrons were different from element to element, showing that the spectra of γ-rays are different. But no γ-rays were observed whose energies exceed 2·4 eMV. Thus it is very probable that the γ-rays are phosphorescence γ-rays excited by neutrons. The cross-sections for the excitation of γ-rays are compared wtih those for absorption of neutrons and also for the production of slow neutrons by the passage of neutrons through the matter. AUTHOR.

3515. γ-Spectra of RaB and RdAc. S. Rosenblum and M. Guillot. *Comptes Rendus,* 204. *pp.* 1727–1729, *June* 7, 1937.—Five of the γ-rays of the two elements are identical. Several of the other rays of both show the presence of 30·6 and 52·9 ekV as fundamental energies involved in the two radioactive changes. H. G. C.

3516. Effect of Secondary β-Radiation on γ-Ray Measurements in Air. C. W. Wilson. *Phys. Soc., Proc.* 49. *pp.* 338–343; *Disc.,* 343–344, *July* 1, 1937.—A sensitive method of measuring small ionisation currents is described, and the effect of secondary β-radiation upon ionisation measurements of γ-radiation is examined. It is shown that if ionisation chambers made of light-atom materials have walls less than 4·0 mm. thick, secondary β-radiation is recorded so that readings are in excess of the true values. The results explain some discrepancies found by other workers. AUTHOR.

3517. Photoelements with Absorbing Films for Radioactivity Measurements. P. Bonét-Maury. *Comptes Rendus,* 204. *pp.* 1641–1643, *May* 31, 1937.—Ionisation chamber methods not being applicable to intense radiation, it is found that photoelements irradiated by α- or β-rays give rise to a p.d. as under the incidence of light; hence the measurement of strong α-ray sources has been effected by causing the rays to act on a ZnS screen in front of the photoelement (Se), or directly on the photoelement screened from light by thin metallic films permeable to the α-rays. A critical discussion of the two methods is given. N. M. B.

See also **Abstracts 3308, 3312, 3313, 3371, 3393, 3559, 3706, 3770.**

RADIATION.

ABSORPTION AND TRANSMISSION.

3518. Colour of Bodies by Reflection. L. Amy, C. Sannié and J. M. Sarraf. *Rev. d'Optique,* 16. *pp.* 81–92, *March,* 1937.—If α is the coefficient of absorption, δ that of diffusion and h the thickness of a thin layer, then the diffused light transmitted (T) and reflected (R) is given by $\log_e T = -(\alpha + \delta)\,h$ and $R = \delta/2(\alpha + \delta)$. As it is impossible to measure α and δ the equations are verified by (1) tinting paper (α variable, δ constant) (2) immersing porous solids in liquids of various refractive indices (α constant δ variable). H. G. C.

3519. Far Infra-Red Transmission of MnO, CuO, SrO, GdO and BaO. M. Parodi. *Comptes Rendus,* 204. *pp.* 1636–1638, *May* 31, 1937. —By the residual ray method the absorption of the oxides between 20 and 70 μ is observed. Plotting absorption wave-length against atomic number of the metal gives a smooth curve. The compressibilities of the crystals are calculated by Born's formula and compared with the experimental values in the cases of CaO and BaO. H. G. C.

See also Abstracts 3562, 3563, 3565.

COLORIMETRY.

3520. Colour Mixing. V. H. Pavlović. *Comptes Rendus,* 204. *pp.* 1635–1636, *May* 31, 1937.—A Newton's disc with 48 coloured segments is examined in a flashing light. By varying the speed of rotation and the frequency of the light flashes many combinations of colours can be obtained. H. G. C.

***3521. Colorimetry of Point Sources of Light. A. Blondel.** *Comptes Rendus,* 204. *pp.* 1695–1698, *June* 7, 1937.—The ordinary methods of colorimetry cannot be applied to point sources of light and, further, the colour of a given signal may change when it is near the limit of visibility so that colorimetry of the signal at close quarters is of no use. The only process which can be applied with certainty is comparison under conditions as nearly as possible identical with those found in practice. The author describes a colorimeter in which the light to be measured is reduced to "point" dimensions and then compared with a point standard of controllable colour. J. W. T. W.

See also Abstract 3540.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

3522. Magnetic Rotatory Power of NO. H. Bizette and B. Tsaï. *Comptes Rendus,* 204. *pp.* 1638–1640, *May* 31, 1937.—The magnetic rotatory power of NO has been measured at constant density between 18 and − 80° C. The ratio of Verdet's constant to the density decreases with increasing pressure at − 80° C. The rotatory power is less than that calculated at low temperatures. These facts are explained by postulating polymerisation at − 80° C and at high pressure. The degree of polymerisation is estimated. **Errata,** *ibid. p.* 1965, *June* 28, 1937. H. G. C.

3523. Magnetic Birefringence of Compressed NO and Magnetic Rotatory Power of He. H. Bizette and B. Tsaï. *Comptes Rendus*, 204. *pp*. 1870–1871, *June* 21, 1937.—Measurements of the magnetic double refraction of compressed NO are in good agreement with expressions derived from the formulæ of Langevin-Born and of van Vleck. It has a minimum value at − 57° C and changes sign at − 138° C. A value 0′·45 × 10^{-6} is obtained for Verdet's constant for He, in agreement with that predicted by de Malleman and Gabiano. C. B. A.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

3524. Sensitised Thallium Fluorescence at High Mercury Vapour Pressures. S. Mrozowski. *Acta Physica Polonica*, 6. 1. *pp*. 58–67, 1937. *In German*.—The sensitised fluorescence of Tl vapour, produced by collisions with excited Hg_2 molecules, is investigated. The experiments are carried out with different Tl vapour pressures and a constant Hg vapour pressure of 5 cm., the Hg_2 molecules being excited by means of Al and Zn spark emission. The intensity distribution in Tl fluorescence is found to differ from that in the Tl fluorescence sensitised by Hg atoms. It appears that in the corresponding experiments of Orthmann and Pringsheism the contribution of Hg_2 molecules to the sensitisation of Tl fluorescence must have been very considerable. J. E. K.

3525. Fluorescence of Gadolinium Salts and Their Solutions. R. Tomaschek and E. Mehnert. *Ann. d. Physik*, 29. 3–4. *pp*. 306–310, *June*, 1937.—It has been shown that the rare earths both in the pure state and in solution fluoresce with an intensity which decreases with the distance of the rare earth element from Gd in the periodic table. It would therefore be expected that Gd salts would be especially brilliant. Also since Gd salts show a very strong u.v. absorption whose longest waves are at 3110 Å, a corresponding u.v. fluorescent emission should be found at the long wave end of the absorption spectrum. Such a fluorescent emission has now been found for the first time, both for the pure salts and for their aqueous solutions. The spectrum of this overlaps and coincides with the absorption spectrum at the long wave end of the latter. The spectra of the solid and solution coincide. J. E.

3526. Fluorescence of Rare Earths in Solution. Part I. O. Deutschbein and R. Tomaschek. *Ann. d. Physik*, 29. 3–4. *pp*. 311–323, *June*, 1937.—The fluorescence spectra of rare-earth salts in water and other organic solvents are investigated from room-temperature down to −180° C. In the case of Eu the excitation spectrum has been found and related to the term scheme of Eu^{+++}. J. E.

3527. Analytical Determination of Rare Earths by Fluorescence and Absorption. H. Gobrecht and R. Tomaschek. *Ann. d. Physik*, 29. 3–4. *pp*. 324–331, *June*, 1937.—It is shown that a rapid determination of the rare earths present in a mixture is possible by the use of absorption and of fluorescence spectra. The limits of the sensitivity of this method is discussed. The application to quantitative determination will be discussed later. J. E.

See also Abstract 3605.

INTERFERENCE, DIFFRACTION AND SCATTERING.

***3528. Application of Light Interference in Technical Measurements. T. Zobel.** *V.D.I.* 81. *pp*. 619–624, *May* 29, 1937.—The author describes an interference refractometer designed for the investigation of

the variations of refractive index from point to point in a transparent medium produced, *e.g.*, by the presence of a hot body or by the passage of a moving body such as a bullet. The design of the apparatus is straightforward. Two half-platinised mirrors are employed to split up and recombine the interfering beams one of which has passed through the medium under study. A number of photographs of the interference patterns obtained with the apparatus are included and their interpretation is discussed. An accuracy of determination of small differences of refractive index 1000 times that given by the Schlieren method is claimed.
W. S. S.

3529. Scattering of Light by Electric Fields in the Theory of the Positron. Part II. N. Kemmer and G. Ludwig. *Helv. Phys. Acta.* 10. 3. *pp.* 183–184, 1937. *In German.*—Continuing an earlier paper [see Abstract 2056 (1937)], the author gives an expression for the effective cross-section for the scattering of light of wave-length λ by a nucleus of charge $Z|e|$, in the following form: $z = (e^2/mc^2)^6 \ (Z/\lambda)^4 \ [(C_1^2+C_2^2)(1 + \cos^2\theta) + 2C_1C_2\cos\theta]$ the case $\lambda \gg \hbar/mc$ being supposed. The expression is obtained from the theory of positrons. The numerical values of the constants C_1 and C_2 are obtainable only with difficulty; they are certainly not large compared to unity and are probably much smaller.
G. O. B.

3530. Dispersion of Depolarisation of Light-Scattering in Colloids. R. S. Krishnan. *Indian Acad. Sci., Proc.* 5*A*. *pp.* 407–418, *May, and pp.* 499–509 *and* 551–563, *June,* 1937.—Extension of previou work to Pt, Cu, Se, Te, I_2, graphite, stearic acid, V_2O_5, As_2S_3, and $Fe(OH)_3$ sols and colloidal dye-stuffs. [See Abstract 3049 (1937).]

***3531. Resolving Power of Interferometers and their Use as Monochromators. M. Cau and F. Esclangon.** *Rev. d'Optique,* 16. *pp.* 41–63, *Feb., and pp.* 93–103, *March,* 1937.—The theories of Fresnel and Gouy are applied to results obtained by using an interferometer as a monochromator and analysing the transmitted radiation in a second interferometer. Either theory will explain the results. The problem is investigated theoretically and experimentally.
H. G. C.

See also Abstracts **3340, 3548, 3561, 3569, 3572, 3682, 3683, 3684, 3774.**

PHOTOCHEMISTRY, INCLUDING PHOTOGRAPHY.

3532. Rate of Photochemical Reactions. B. J. Svešnikov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 4. *pp.* 177–182, 1937. *In English.*—Deals with the dependence of the rate of photochemical reactions in solution on the concentration of reagents. Previously published results [see Abstract 627 (1936)] have shown, from the influence of viscosity on the rate of reaction, that the mean life of the molecule in the active state is considerably greater than the time between two consecutive solute-solvent collisions. This conclusion can also be reached by taking into account the fact that the velocity of reaction is often decreased by the increasing concentration of the reagents, and it is this phenomenon which is mathematically considered in greater detail in the present paper.
R. C. F.

3533. Photo-Decomposition of Deutero-Ammonia. E. O. Wiig. *Am. Chem. Soc., J.* 59. *pp.* 955–958, *June,* 1937.—The photo-decomposition of NH_3 is found to proceed about 1·3–1·5 times as rapidly as that of ND_3 in the predissociation bands at 2100 Å. Approximately the same ratio holds for the rate of decomposition of ND_3 at 2138 Å in a discrete band to that at 2100 Å. in a diffuse band. These differences in rates are discussed and explanations to account for them suggested. AUTHOR.

3534. Primary Photochemical Processes in Solution. G. K. Rollefson and W. F. Libby. *J. Chem. Phys.* 5. *pp.* 569–571, *July*, 1937.—The effect of an inert solvent on the efficiency of photodissociation processes is discussed. It is shown on theoretical considerations that under the usual experimental conditions a close analogy betweeen reactions in solution and in the gas phase cannot be accounted for by assuming a symmetrical retardation of both the dissociation and recombination processes by the solvent. It is shown experimentally by means of the radioactive indicator method that even in the ideal case of Cl_2 in CCl_4 the atoms produced in the photodissociation process do not react with the solvent. AUTHORS.

3535. Graininess, Density Variation and Enlargement Capacity of Photographic Negatives. H. Siedentopf. *Phys. Zeits.* 38. *pp.* 454–459, *June* 15, 1937.—Theoretically examines the relation between grain size and density variations obtained with " micro " photometry, and grain size and enlargement capacity, the results obtained being compared with practical experience. The contrast dependency of visual resolving power in association with density variations leads to a new conception of the enlargement capacity of negatives, thus giving rise to a new treatment in the measurement of the graininess of negatives. R. C. F.

3536. Medium-Free Silver Bromide Layers. Lüppo-Cramer. *Kolloid Zeits.* 79. *pp.* 215–220, *May*, 1937.—Further work, using Ollendorff and Rhodius' technique of a rubber sub-coat to plates coated with gelatin-free AgBr, showed the rubber sub-coat to produce a marked loss in sensitivity which was due, not to chemical desensitisation, but to a reduced wetting-facility. The second technique, of applying a collodion supercoat to protect the layer during fixation, gave rise to a gain in sensitivity. The method has a possible application in u.v. photography (Schumann-type plates). [See Abstract 3056 (1937).] L. V. C.

3537. Photographic Plates Sensitised with Sodium Salicylate. L. Herman and Fanny Bernstein. *Comptes Rendus,* 204. *pp.* 1868–1870, *June* 21, 1937.—Further experiments with plates treated with sodium salicylate are described. It is found that the influence of the salt on the development is very small ; and that at densities below 2 this treatment reduces the sensitivity at all wave-lengths from 6000 to 2500 Å. Explanations are suggested. [See also Abstract 628 (1937).] C. B. A.

★3538. Radial-Stereoplotter. E. L. M. Burns and R. H. Field. *Canad. J. of Research,* 15. *Sect.* A. *pp.* 85–99, *June,* 1937.—A machine for plotting from air photographs, by the radial line method, has been developed by the Associate Research Committee on Surveys. The purpose of the plotter is to increase the accuracy and speed of extending minor control through strips of photographs by this method which is so widely used in Canada. A description of the machine is given, preceded by a brief explanation of the principles underlying its design. The methods so far employed in using the plotter are explained together with an examination of the sources of error arising in these methods, some of which are of general application to radial line plotting. Owing to the short time that the radial-stereoplotter has been in operation, conclusive statements cannot be made as to the results it will give when handled by an experienced operator, but already there is evidence of a considerable saving of time and gain in accuracy as compared with hand graphical methods of extending radial line control. AUTHORS.

***3539. Modification of Camera Range-Finder. T. A. Littlefield.** *Journ. Sci. Instruments*, 14. *pp.* 229–231, *July*, 1937.—Modern cameras equipped with range-finders, so coupled to the lens that focusing is accomplished by adjusting the range-finder images to coincidence, lose this advantage when the camera lens is supplemented by a second converging lens for the photography of objects at close range. The advantage of focussing by adjustment of the range-finder is, however, especially desirable under these conditions in view of the very limited depth of field, and it may be preserved if the indirect window of the range-finder be provided with a supplementary prism, chosen to match the focal length of the supplementary lens. AUTHOR.

See also Abstracts 3595, 3596, 3597, 3662.

PHOTOMETRY.

3540. Nomenclature for Photometry and Colorimetry. L. A. Jones. *J.O.S.A.* 27. *pp.* 207–213, *June*, 1937.—This is a report of the American Committee on Colorimetry, but it contains a proposed complete nomenclature for photometric quantities. The principal changes suggested are (1) the use of "illuminance" as the quantitative expression for illumination, the latter being restricted to a non-quantitative meaning, (2) the adoption of "luminance" for brightness (expressed in $c/\text{cm.}^2$), and (3) the restriction of "radiance" to radiometric uses, the term "luminous emittance" being proposed for the quantity expressed as lumens emitted per cm^2. The tendency to use "luminosity" for "visibility" is given approval. The properties of a body are termed "reflectance," etc., while in the case of a material the terms "reflectivity," etc., are used. Finally, a set of definitions of the colorimetric terms is given. J. W. T. W.

***3541. Use of Colour Filters in Visual Photometry. E. F. Little and R. S. Estey.** *Am. Illum. Eng. Soc., Trans.* 32. *pp.* 628–645, *June*, 1937.—With the exception of certain special cases colour differences are common in visual photometry. In order to permit an accurate brightness match the colour difference must be eliminated—usually by means of filters. Since the selection of colour matching filters by trial and error is obviously unsatisfactory, principles are enunciated which make the selection of colour matching filters easier and more accurate. This selection involves the colour characteristic of individual observers as compared with a hypothetical standard observer. In this connection the influence of field size and field illumination are discussed. All colours can be represented on a mixture diagram which is the modern equivalent of Maxwell's colour triangle. By plotting the colours being photometered on such a diagram and by including the effect of filters likely to be useful the best colour matching filters can readily be found. Particular filters are described and their calibrations shown for use in raising and lowering colour temperature and matching Hg and Na. The type of filter for matching Ne, carbon arc and other sources is suggested. Errors and difficulties peculiar to this branch of photometry are described. AUTHORS.

3542. Photometry of Gas-Discharge Lamps. L. B. Johnson. *Am. Illum. Eng. Soc., Trans.* 32. *pp.* 646–657 ; *Disc.*, 657–664, *June*, 1937.—This paper discusses heterochromatic photometry of gas-discharge light sources with special emphasis on the measurement of the type-H Hg lamps, formerly known as high-intensity Hg lamps. There is an introduction describing the problem, followed by a discussion of its treatment here and abroad, including colour matching filters and their selection, the effect of subjective colour match without energy match, Purkinje and yellow spot effects with respect to the size and illumination of the photometric field. The methods of measurement including the use of photometric spheres are outlined. AUTHOR.

*3543. **Photometry with Rectifier Photo-Cells. R. Sewig.** *A.T.M. No.* 71. *T*62–*T*63, *May*, 1937.—Describes the characteristics of the rectifier photo-cell, particularly as regards their effect on the use of such cells for photometric measurement. The matters dealt with in detail include (1) the effect of varying the external resistance in the circuit, (2) the departures from linearity at very high and very low illuminations, (3) the effect of red and infra-red radiation, (4) departures from the cosine law of illumination, and (5) errors due to temperature variations. The concluding sections describe different forms of circuit used for photometry with cells of this type, especially the various compensating forms of circuit. J. W. T. W.

3544. Heterochromic Precision Photometry by Thermopile and Combination Filter. H. König. *Helv. Phys. Acta*, 10. 3. *pp.* 165–181, 1937. *In German.*—The possibility is considered of obtaining a combination glass filter whose transmission function is almost the same as the international luminosity function V (λ). The construction and theory of such a filter are investigated. In combination with a non-selective recording device, *i.e.*, a thermopile, such a filter produces an ingenious recording " eye," whose degree of adaptability and sensitivity are sufficient to make possible, with a considerable degree of accuracy, such important measurements as that of the horizontal intensity of incandescent lamps and gas-discharge tubes. In addition such a device furnishes the basis of a process of absolute measurement of the colour temperature of incandescent lamps. G. O. B.

*3545. **Photo-Cells for Measurement of Visible Light. P. Görlich and W. Lang.** *Zeits. f. Instrumentenk.* 57. *pp.* 249–250, *June*, 1937.—The authors describe a compound photo-cell comprising a glass bulb one hemisphere of which is coated internally with a partially transmitting film of kathode material (Cs-Bi, Cs-Sb, Cs-Tl, or Cs-Pb) and the other hemisphere with an opaque kathode layer (Cs-Cs_2O-Ag). The light enters through the partially transmitting layer and stimulates both kathodes. The long-wave maximum of sensitivity of the partially transmitting kathode is situated near the wave-length of minimum sensitivity of the opaque kathode and the cell as a whole is approximately equally sensitive throughout the visible spectrum. Certain other advantages of the compound cell are indicated. W. S. S.

*3546. **Reliability of Blocking-Layer Cells in Microphotometry. A. E. Sandström.** *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 25*B*. *No.* 18. [4 *pp.*], 1937. *In English.*—The proportionality between the galvanometer deflection of the Siegbahn registering micro-photometer equipped with a blocking-layer cell and the intensity of the light reaching the cell is tested and found satisfactory. Continuous exposure of the cell to the maximum intensity of the light beam for a period of twelve hours produces no disturbance of the linearity. W. S. S.

See also Abstracts 3571, 3620.

POLARISATION.

3547. Depolarisation of Light Diffused by Argon. A. Rousset. *Comptes Rendus*, 204. *pp.* 1725–1727, *June* 7, 1937.—Argon, 99·8% pure, contained in a cross-shaped tube was illuminated by light polarised in the plane of diffusion and the light scattered at right angles examined. Using a variable aperture and extrapolating to zero a depolarisation factor of 3×10^{-4} is obtained. H. G. C.

***3548. Polarimeter for Study of Diffracted Light. J. Savornin.** *Rev. d'Optique*, 16. *pp.* 64–69, *Feb.*, 1937.—A method is described of analysing polarised light diffracted at a straight edge. Applications of the method, which is particularly suitable when the beam in the analyser is not in line with the incident ray (reflection etc.), are given. H. G. C.

See also Abstracts 3530, 3608.

RADIATION, EMISSION.

***3549. Absolute Radiometry. J. Guild.** *Roy. Soc., Proc.* 161*A*. *pp.* 1–38, July 1, 1937.—In Part I a form of absolute radiometer is described in which the radiation to be measured is absorbed by a Pt foil coated with lamp black and dry mounted on to a massive Cu disc. The rate of rise of temperature of this disc with respect to a second similar disc placed opposite to and insulated from the first, is measured by means of thermocouples formed by Eureka wires connecting the two discs. The Pt foil is cut so as to form a grid through which current can be passed and a known amount of heat generated in the foil. The comparison of the absorbed heat and the heat generated electrically is based on the temperature changes in a special cycle of heating and cooling periods designed to eliminate certain errors. An accuracy of measurement of one part in a thousand is claimed. In Part II the comparison of the new radiometer and a second instrument of somewhat different design with the Callendar radio-balance is described. All three instruments gave results agreeing to about 1 part in 1000 and strong evidence is provided for the absolute accuracy of the N.P.L. scale of thermal radiation which is based on these instruments. In Part III the N.P.L. scale is compared with other scales. Close agreement with the scale of the National Bureau of Standards is recorded. The Smithsonian scale is found to over-value the radiation by 2·3% and the Ångstrom scale to under-value by 0·5%. W. S. S.

***3550. Increased Sensitivity of Radiation Measurements by the Thermophotometric Method. M. Plotnikow, Jr.** *Acta Physica Polonica*, 6. 1. *pp.* 12–18, 1937. *In German.*—The sensitivity of the thermophotometric method is examined when discs of platinised Pt, smoked paper and cotton wool, wire nets of platinised and smoked Pt and layers of graphite of various thicknesses are used as receivers. Graphite appears to be the best substance and platinised Pt the worst. A quicker, but less accurate, method of measuring radiation intensities is the manometric arrangement, whereby the rate of rise of a liquid in a manometer tube is measured; the tube is attached to a box closed with the receiving disc and, as a result of the improvement made in the discs, the apparatus is now a sensitive one. H. J. H. S.

***3551. Radiometer Depending on the Principle of a Gas Thermometer. M. Veingerov.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 14. 7. *pp.* 427–428, 1937. *In German.*—The factors affecting the sensitivity of the radiometer are briefly summarised [see Abstract 5116 (1936)] and the results of some further numerical work are given. The following expressions are derived: $\Delta Q = Jcr^2/6K$, $\Delta T = J/8\pi Kr$ and $\Delta V = Jr^2\beta/6K$, where ΔQ, ΔT and ΔV are the changes in heat content, temperature and volume of the gas respectively, J is the incident light intensity (in erg/sec.), K is the thermal conductivity of the gas of heat capacity c per c.c., r is the radius of the vessel containing the gas and β is the coefficient of thermal expansion of the gas. The conditions under which these relations hold true is clearly laid down. A method is described for increasing ΔT and for decreasing the inertia of the radiometer. H. J. H. S.

3552. Spectral Intensity of Black Radiation in the Region of High Vibration Numbers. E. Kretschmann. *Zeits. f. Physik*, 105. 11–12. *pp.* 645–657, 1937.—If the spectral intensity of black radiation is determined in the region of short waves through analysis within a finite interval of time, or if it is measured by the number of quantum jumps of atoms or molecules forced by it, there is obtained, besides the spectral intensity following upon Planck's law, from time to time an additional but inseparably connected " scattering intensity " the relative magnitude of which with rising vibration number increases beyond all limits. The scattering intensity gives rise to asymmetrical frequencies of transition of atoms between two states. J. J. S.

3553. Mechanism Involved in the Production of Cosmic-Ray Showers. P. Auger, P. Ehrenfest, Jr., A. Freon and T. Grivet. *Comptes Rendus*, 204. *pp.* 1797–1799, *June* 14, 1937.—Using a number of coincidence counters grouped in various ways the number of showers obtained in Paris as a function of the thickness of a lead screen, is examined. For showers of two particles a maximum occurs with 15 mm. of Pb, for three particles with 23 mm. of Pb. These results, together with others obtained on the Jungfraujoch, gives strong support to the mechanism of shower production proposed by Bhabha and Heitler. F. C. C.

3554. Intensity of Cosmic Radiation in Capetown. B. F. J. Schonland, B. Delatizky and J. Gaskell. *Terr. Mag.* 42. *pp.* 137–152, *June*, 1937.—This paper presents an analysis of the results of three years' photographic registration of the ionising power, briefly called the intensity, of the cosmic radiation in Capetown, South Africa. The measurements, which were made at hourly intervals, have been undertaken as part of an international scheme, under the general direction of E. Steinke, of the University of Königsberg. The instrument used is one of a number of identical construction and mode of operation made under Steinke's supervision. The data obtained from this and the other stations of the group are to be collated and compared in a forthcoming publication. They have already been utilised in a joint report upon the intensity of the radiation at the time of the appearance of Nova Herculis [see Abstract 182 (1936)]. No long-continued observations of this nature have yet been made in the Southern Hemisphere and as the Capetown station is the only one of the group situated below the Equator its results are of special interest. AUTHORS.

3555. Analysis of Cosmic Rays. W. Heitler. *Roy. Soc., Proc.* 161*A*. *pp.* 261–283, *July* 15, 1937.—An attempt has been made to analyse cosmic rays on either of the two assumptions: (*a*) The particles constituting the hard component which are capable of traversing more than 20 cm. Pb are not electrons. The quantum theory is valid for electrons up to infinitely high energies. (*b*) The highly penetrating particles are electrons. The quantum theory breaks down for energies above a critical energy E_c. According to assumption (*a*) it is shown that the intensity curve in the atmosphere can be explained by a suitable primary energy spectrum for electrons from which results can be deduced about the latitude effect and the variation of shower intensity with altitude and latitude. These results are all at least in qualitative agreement with the observations. From the primary energy spectrum the energy spectrum of the soft radiation at each altitude can be deduced. For altitudes below 4300 m. the energy spectrum follows approximately a $dE/E^{2\cdot5}$ law and is practically independent of the altitude. This is in qualitative agreement with experiments. Under assumption (*b*) it has been shown that the intensity curve in the atmosphere can only be explained if the critical E_c is to be assumed to lie for air at least as high as $5 \times 10^9 - 10^{10}$ eV. AUTHOR.

3556. Decrease of Hard Primary Cosmic Rays in Matter. J. Clay, J. T. Wiersma and E. M. Bruins. *Physica*, 4. *pp.* 521–526, *July*, 1937. *In English.*—The decrease of hard cosmic primaries is determined in Hg, Pb, Fe, Sn, S and H_2O, under layers up to 1300 gm./cm^2. It was established that the decrease depends on the mass and not on the electron density of the dimension of the nucleus. The coefficient of decrease is decreasing with the thickness of the layers. On account of these two facts and the constancy found of the number of coincidences between 230 and 330 m. water equivalent, it is suggested that the protons are partly replaced by neutrons and partly lost by energy-loss in ionisation, showers and radiation. [See also Abstract 3625 (1936).] AUTHORS.

3557. Absolute Intensity of Ionisation in Argon by Cosmic Radiation at Sea-Level. J. Clay and K. Oosthuizen. *Physica*, 4. *pp.* 527–530, *July*, 1937. *In English.*—With the arrangement with which the intensity was found in air [see Abstract 1634 (1937)] the ionisation was determined in argon at pressures between 38 and 1 atmos. under layers of 12 cm. Fe and under 56 cm. Fe. The intensity reduced to the value for 1 atmos. is 1,58 I, under 12 cm. Fe and 1,46 under 56 cm. Fe. The energy of the electrons ejected from the iron walls is less under 56 cm. Fe (max. 45 cm.) than under 12 cm. Fe (max. 54 cm.) AUTHORS.

3558. Variation of Cosmic-Ray Intensity. J. Barnóthy. *Zeits. f. Physik*, 105. 9–10. *pp.* 642–644, 1937.—The author considers that certain variations in cosmic-ray intensity observed by Ehmert, from which conclusions were drawn regarding the directional effect of the radiation and the variation of intensity with sidereal time [see Abstracts 185 and 4165 (1936)] were statistical in origin, and were not systematic. D. H. F.

See also Abstracts 3450, 3504, 3605, 3735.

RADIATION, GENERAL THEORY.

3559. Recent Developments in the Theory of the Neutrino. J. Solomon. *J. de Physique et le Radium*, 8. *pp.* 179–184, *May*, 1937.—The author shows how the application of the theory of neutrinos to β-ray disintegration, the interaction of neutron and proton, the production of showers of cosmic rays and the magnetic moment of the proton and the neutron lead in each case to certain difficulties. These appear to lead to the conclusion that the Fermi expression for the energy of interaction of heavy and light particles requires modification, possibly by the inclusion of terms involving the derivatives of the wave functions as suggested by Uhlenbeck and Konopinski. W. S. S.

3560. Modern Theories of Light. L. de Broglie. *Ann. Soc. Sci. de Bruxelles,* 57. *pp.* 99–119, *June* 7, '1937.—This lecture contains a detailed account of the development of the author's theory of light. The reasons for the failure of his earlier photon theory are described, and the later conception of the photon as consisting of a pair of complementary particles is explained and related to the experimental facts. Jordan's neutrino theory is criticised. C. B. A.

3561. Scattering of Light by the Electrostatic Field of a Point Charge. S. Šubin and A. Smirnov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 15. 3. *pp.* 131–135, 1937. *In English.*—The effect of the electrostatic field of a point charge on a light wave is worked out from the standpoint of the simplest non-linear theory of electrodynamics. G. C. McV.

See also Abstracts **3447, 3529.**

REFLECTION, REFRACTION AND DISPERSION.

3562. Optical Constants of Cu-Zn Alloys. H. Lowery, H. Wilkinson, and D. L. Smare. *Phys. Soc., Proc.* 49. *pp.* 345–353, *July* 1, 1937.—Values of the optical constants (refractive index, reflection coefficient and absorption coefficient) are given for some alloys of the Cu-Zn system (α, β and γ brass) over the range λ 4358 to λ 6800, as determined by the method of Drude. Curves showing the variation in the optical constants with composition for particular wave-lengths of light are also shown. [See also Abstracts 3863 (1935) and 5542 (1936) and following Abstract]. AUTHORS.

3563. Theory of Optical Constants of Cu-Zn Alloys. N. F. Mott. *Phys. Soc., Proc.* 49. *pp.* 354–356, *July* 1, 1937.—The results of the experiments of Lowery, Wilkinson and Smare (see preceding Abstract] on the optical constants of alloys of copper and zinc (α, β and γ brass) are discussed from the point of view of the electric theory of metals. AUTHOR.

3564. Knife-Edge Test for Spherical Aberration. R. Kingslake. *Phys. Soc., Proc.* 49. *pp.* 376–380, *July* 1, 1937.—A method is given for computing the appearance seen in the knife-edge test, for various positions of the edge in various focal planes, when any specified amount of aberrration is present. Series of patterns are given corresponding to (a) pure primary spherical aberration, and (b) zonal aberration with marginal correction. AUTHOR.

3565. Dispersion and Absorption of Lithium and Sodium Fluorides in the Infra-Red. H. W. Hohls. *Ann. d. Physik,* 29. 5. *pp.* 433–448, *July,* 1937.—Measurements are given for (i) refractive indices of LiF between 0·55 and 15·8 μ and between 39 and 55 μ; of NaF from 0·55 to 24 μ and from 48 to 55 μ; and of NaCl and KCl between 23 and 29 μ; (ii) the absorption constants of LiF from 4·5 to 15·8 μ and of NaF from 7·5 to 24 μ; and (iii) the reflection power of NaF and LiF up to 55μ. W. R. A.

3566. Transformation Points of Glasses. P. Bary and J. Herbert. *Comptes Rendus,* 204. *pp.* 1809–1811, *June* 14, 1937.—From recent work it has been established that the fusion of vitreous matter and particularly of glasses is not a continuous phenomenon but that singular points occur corresponding to abrupt charges in the values of certain physical properties. The first transformation point T_1, is observed when the substance begins to become deformable by pressure, *i.e.*, when it is plastic; a second point T_2 was determined by le Chatelier from the viscosity data of Washburn and Shelton and of English as a function of the temperature between 500–1400°. The existence of these two points indicates a clear distinction between the viscosity and the plasticity of semi-solid bodies which are only deformable under a minimum force, and the present paper records an experimental study of these phenomena by a new method. It has been established for a series of glasses in which, while the silica content was constant, the relative proportions of lime and soda varied, that the plasticity was represented by a series of parallel lines which intersected the axis of logT at the point T_1 of each of the glasses. Like results were obtained from a series of silica-magnesia-soda glasses. The points T_2 were not determinable to the same degree of accuracy as T_1. H. H. Ho.

***3567. Gases in Optical and Other Glasses. C. Hahner, G. Q. Voigt and A. N. Finn.** *Bureau of Standards, J. of Research,* 19, *pp.* 95–103, *July,* 1937.—An apparatus and method for removing by vacuum fusion the gases dissolved in glass and for determining the quantity of gases are described. Determinations of gases in three types of optical glass and seven commercial glasses were made. Approximately the same quantities of water were found in the optical and the commercial glasses, but the total volume of other gases, such as CO_2, SO_2, O_2, etc., never exceeded 10 ml. per 100 gm. of optical glass, while the window glass contained from 34 to 73 ml. per 100 gm. of glass. In the optical glasses, especially the light barium crown glass, there was no indication of a relation between the quantity of gas obtained and the number of " seeds " in the glass, nor was there any significant change in the gas content of the glass during the stirring and fining periods. AUTHORS.

***3568. Mirror Systems. H. Schulz.** *Zeits. f. Instrumentenk.* 57. *pp.* 251–254, *June,* 1937.—The possibility of an aberration-free system of two spherical mirrors is investigated. C. B. A.

***3569. Increased Resolving Power of Microscopes and Telescopes. E. Lau.** *Phys. Zeits.* 38. *pp.* 446–449, *June* 15, 1937.—A diffracting edge is introduced between a lens and the image of a point source formed by it. It is shown that the normal diffraction pattern produced by the lens is thus made sharper, and an experimental demonstration is reproduced. The application of this system to increasing the resolving power of telescopes or microscopes is outlined. C. B. A.

***3570. Apochromatic and Achromatic Microscope Objectives. A. Sonnefeld.** *Zeits. f. Instrumentenk.* 57. *pp.* 235–239, *June,* 1937.—The distinction given in text books between an apochromatic and an achromatic objective is important for astronomy but less so for microscopy. Two distinct methods are outlined to provide the necessary conditions for microscope objectives and to state the chromatic aberration. The necessary consideration is given to the colour deviation for axial, zonal and marginal deviation. The results obtained practically agree with theory. With an apochromat three colours can unite but big difficulties exist. For the microscope objective suitable choice of glass and greater illumination decrease such difficulties and a semi-apochromat is advised. R. S. R.

***3571. Luminosity of Telescope Images. L. Martinelli.** *Accad. Lincei, Atti,* 25. *pp.* 185–188, *Feb.* 21, 1937.—The author measures the luminosity of the image formed by a telescope for different magnifications and different sizes of the exit pupil at the eye. The results confirm that the brightness of the image is not proportional to the pupil area for a given magnification but increases less rapidly with increase in pupil area. A formula is derived relating the brightness of the image with the magnification and pupil area. W. S. S.

***3572. Interference Refractometer for Biological Applications. R. Jonnard.** *Rev. d'Optique,* 15. *pp.* 425–430, *Dec.,* 1936.—The instrument described employs the principle of Rayleigh's interference refractometer and is designed to deal with liquids of which only a few drops are available. The design aims at rapidity of operation and simplicity of calibration. W. S. S.

***3573. Refractometer for Near Infra-Red. R. Kingslake and Hilda G. Conrady.** *J.O.S.A.* 27. *pp.* 257–263, *July,* 1937.—A convenient apparatus for making refractive index measurements on a 60° prism, in the near infra-red region. The instrument is essentially a double Wadsworth mirror monochromator, the first half being calibrated in wave-lengths, and the second half calibrated to read angular rotations of the prism table on which the unknown prism is mounted. The wave-length drum was calibrated by working backwards from a known prism (rock-salt or quartz) mounted on the second prism table. Measurements on eleven optical glasses are given, from $0 \cdot 365$ to $2 \cdot 6\mu$. AUTHORS.

3574. Atmospheric Image of a Lighthouse. G. Colange and Y. le Grand. *Comptes Rendus,* 204. *pp.* 1882–1884, *June* 21, 1937.—Observations of the rotating luminous beam of a lighthouse when viewed with one's back to the source gave the impression of a beam diverging from another lighthouse below the horizon. The geometrical explanation of this phenomenon is given and the results have been confirmed by laboratory tests. The ratio of the brightness of the beam measured in directions away from the source and perpendicular to the beam are $7 \cdot 5$ and 16 for apertures of 7° and 2° 20′ but the values vary with the atmospheric conditions. The necessary topographical conditions required to obtain the effect are given. R. S. R.

See also Abstracts 3354, 3518, 3608, 3625.

SPECTROSCOPY.

3575. Paschen Series of Hydrogen and Deuterium. H. Nagaoka and T. Mishima. *Imp. Acad. Tokyo, Proc.* 13. *pp.* 95–97, *April,* 1937. *In English.*—The Paschen series of D, excited by an electrodeless discharge in H_2 and D_2 were photographed for the range 10938–8467 Å., giving members from $m = 6$ to 17. The spectrograms for H_2 and D_2 were nearly the same; the dispersion being about 100 Å/mm. The wave-lengths could be determined to 2 Å. A photometric curve of the spectrum of D_2 is given. Some contamination with O_2 and the presence of resulting lines could not be entirely avoided. N. M. B.

3576. Spectra of K III, Ca IV and Sc V, and the Isoelectronic Sequence Cl I to Mn IX. P. G. Kruger and L. W. Phillips. *Phys. Rev.* 51. *pp.* 1087–1089, *June* 15, 1937.—The successful excitation of highly ionised Sc atoms has enabled the classification of Sc V multiplets which arise from transitions between $3s^2 3p^5\ {}^2P^0$ and $3s3p^6\ {}^2S$; $3s^2 3p^4 4s\ {}^{4,2}P, {}^2D, {}^2S$. Spectrograms of Sc and Ca have been taken with a 21 ft. grazing incidence vacuum spectrograph. The large dispersion and resolution of this instrument enabled the above transitions to be identified in Ca IV also. The identification of these multiplets supplies spectroscopic data necessary to complete the study of the isoelectronic regularities in the sequence. AUTHORS.

3577. Spectra of Sc IV, Ti V, Mn VIII and Fe IX in the Isoelectronic Sequence A I to Fe IX. P.G. Kruger, S. G. Weissberg and L. W. Phillips. *Phys. Rev.* 51. *pp.* 1090–1091, *June* 15, 1937.—The successful excitation of Sc in a vacuum hot spark has enabled the completion of the spectroscopic data in the isoelectronic sequence A I to Fe IX and has led to the identification of radiation connecting the higher terms with the ground state ($^1S_0$) in all ions up to and including Fe IX. AUTHORS.

3578. Arc and Spark Spectra of Lutecium. W. F. Meggers and B. F. Scribner. *Bureau of Standards, J. of Research,* 19. *pp.* 31–39. *July,* 1937.—A new description of conventional arc and spark spectra of Lu in the wave-length range 2000 to 11000 Å has been completed. Wave-length measurements and intensity estimates are presented for 650 lines, 25 of which represent band heads presumably due to LuO, 250 are characteristic of neutral Lu atoms (Lu I spectrum), 370 of singly ionised atoms (Lu II spectrum), and the remainder probably belong to doubly ionised atoms (Lu III spectrum). These data should aid in the spectroscopic identification and analysis of Lu and serve as a basis for further study of spectral structures, hyperfine structures, and Zeeman effects. AUTHORS.

3579. Distribution of Emission and Heat Conduction in Arcs and Sparks. R. W. Schmidt. *Zeits. f. Physik,* 106. 1–2. *pp.* 35–48, 1937.—An investigation is made of the influence of external conditions on the distribution of light emission in arcs and sparks. The various influences affecting the emission in front of the kathode are traced back to a single cause; *viz.*, the transfer of heat from the kathode region. The experiments were carried out with arcs and sparks between Cu, Ag and Fe electrodes at three different arc temperatures and two different spark temperatures. The results of the experiments with Cu electrodes are given in detailed tabular form for the region 2246 to 3036 Å; the results for Ag and Fe electrodes were similar to those for Cu electrodes. From the relation between electrical and optical phenomena in front of the kathode interesting deductions are made relative to the mechanism of electron escape from the kathode and connected questions. J. E. K.

3580. Signs of the Nuclear Magnetic Moments of Li^7, Rb^{85}, Rb^{87} and Cs^{133}. S. Millman and J. R. Zacharias. *Phys. Rev.* 51. *pp.* 1049–1052, *June* 15, 1937.—The atomic beam method of nonadiabatic transitions has been applied to the determination of the signs of the nuclear magnetic moments of Li^7, Rb^{85}, Rb^{87} and Cs^{133}. The experiments show that all of these signs are positive and therefore agree with results known from already hyperfine structure determinations. AUTHORS.

3581. Continuous Spectra at the Series Limit of Line Spectra. H. Bartels. *Zeits. f. Physik,* 105. 11–12. *pp.* 704–724, 1937.—In a typical series line spectrum of an atom, either absorption or emission, and near the series limit, the lines are found to degenerate into a continuous spectrum which often extends beyond the series limit. In a critical discussion of this fact, the author shows that the usual explanation based on an assumption of the recombination of an ion and a free electron is quite inadequate to explain the phenomenon. An explanation is put forward based on wave mechanics which does correctly describe the fundamental properties of this continuous part of a line spectrum, and which can be extended to give an explanation of perturbation phenomena. The method depends on an interpretation of the solutions of the wave equation. Apparent discrepancies between the conceptions appearing in this paper and the treatment of ionisation by collision and the photoelectric effect, are explained. G. O. B.

3582. Infra-Red Reflection Spectra of H_2O, HDO and D_2O. F. Matossi and H. Bluschke. *Zeits. f. Physik,* 104. 7–8. *pp.* 580–583, 1937.—The reflection spectra of liquid H_2O, D_2O and an equilibrium mixture of both with HDO are measured. By subtraction the spectrum of HDO can thus be determined. The position of the maxima are in agreement with the assumption that the interatomic forces are the same in each case, and that the difference between the spectra consists only in the difference of the vibrating masses. The intensity relations are discussed qualitatively. R. P.

3583. MgH Band Spectrum. A. Guntsch. *Zeits. f. Physik,* 104. 7–8. *pp.* 584–591, 1937.—7 bands in the ${}^2\Pi - {}^2\Sigma$ system of MgH are re-measured and partly re-classified. The rotation and oscillation constants are calculated and interpreted with the aid of the corresponding constants for MgD. A new band is found near 4400 Å. It corresponds to a transition from a ${}^2\Sigma^-$ to some ${}^2\Pi$ state. R. P.

3584. Band Spectra of Ionised Hydrogen Halides. Part III. Fine Structure and Isotope Effects. F. Norling. *Zeits. f. Physik,* 106. 3–4. *pp.* 177–204, 1937.—This paper comprises essentially a test of the validity of the quantum mechanical theory of doublet spectra by means of the previously published measurements of HCl^+ and DCl^+ spectra [see Abstract 2106 (1937)] which are particularly suited to this purpose. Whereas in previous tests of the theory molecular states of " pure precession " have been assumed, an attempt is made in this case to estimate the actual matrix elements by which the states are defined. Good agreement is found between experiment and theory, and the basis of the theory which is represented to the experimentalist as interaction between different electron states, appears clearly in the rule that the spin separation in the ${}^2\Sigma$ term for $v = 0$ is nearly equal to the sum of the numerical values of the Λ separations in the ${}^2\Pi$ term for $v = 0$, or more precisely when A is not large that $\gamma \cong p$ for 0 levels. The calculations are based on Morse's radial functions; the possibility of calculation of more certain wave functions is discussed. The hydride-deutride isotopy is investigated and leads to confirmation of van Vleck's theory. For the Cl isotopy there is good agreement between experiment and the simple isotope theory. The term schemes of other hydrogen halides are given and with reference thereto the probable positions of as yet unknown spectra are discussed. J. E. K.

3585. Isotope Effect in the Band Spectrum of Ionised Mercurous Hydride (HgH^+/HgD^+). S. Mrozowski and M. Szulc. *Acta Physica Polonica,* 6. 1. *pp.* 44–57, 1937. *In German.*—The band spectrum of HgH^+ is measured with greater dispersion than hitherto and the derived band constants are compared with the corresponding ones of HgD^+. The constants of HgD^+ used for comparison purposes are corrected values of those derived previously by one of the authors. It is found that within the limits of accuracy of the measurements there are no deviations from the ordinary isotope formula, but on the other hand a relatively large electron isotope effect of $11{\cdot}5$ cm^{-1}. is observed. J. E. K.

3586. Infra-Red Absorption of Mixtures of Water and Organic Liquids. D. Williams, T. Gatica and W. Gordy. *J. Phys. Chem.* 41. *pp.* 645–649, *April*, 1937.—Earlier work has shown that the infra-red absorption of acetone-water and ethyl alcohol-water mixtures exhibits bands not characteristic of either component of the mixture. In the present work a study is made of the absorption spectra of methyl alcohol-water, propyl alcohol-water and glycerol-water mixtures, so that information may be obtained regarding the state in which water exists when dissolved in polar liquids with which it is miscible in all proportions. Details are given of the various absorption curves obtained, and the results are discussed at length. It is concluded that water in alcohol and glycerol mixtures exists in an unassociated state, and that certain bands observed are due to distortion of the water molecules by those of the solvent. A. H.

3587. Infra-Red Absorption Spectra of H_2O Liquid, Solid and in Solution. G. Bosschieter and J. Errera. *Comptes Rendus*, 204. *pp.* 1719–1721, *June* 7, 1937.—Dilute solutions of water in CCl_4 and CS_2 give a similar absorption to that of water vapour, because of the absence of any hydrogen linkages. In ice and water the absorption is quite different. The bands at 3500 cm^{-1}. (stronger in water) are attributed to H linkages between two or more molecules close together: the 3200 bands (stronger in ice) to a (crystal) structure of polymolecules in which each O is surrounded by 4H. H. G. C.

3588. Infra-Red Absorption of OH. P. Barchewitz and R. Freymann. *Comptes Rendus*, 204. *pp.* 1729–1732, *June* 7, 1937.—The presence of groups such as $C - Cl$, $C = C$, $C = O$ produces a doubling of the OH band in organic molecules (fundamental 3600ν). The effects of temperature and dilution are discussed. The perturbing effect of the groups may be an intermolecular or a molecular phenomenon. The displacement of the bands is related to the moments of the perturbing group. H. G. C.

3589. Rotation of Water Molecules in Carbon Disulphide Solution. E. L. Kinsey and J. W. Ellis. *Phys. Rev.* 51. *pp.* 1074–1078, *June* 15, 1937.—The absorption spectrum of water dissolved in CS_2 is investigated for the combination bands whose centres for the vapour lie at 1·135, 1·379 and 1·875μ. Percentage transmission curves for the bands show vapour-like absorption the minima of which fall in the position of vapour minima analysed by Mecke into P and Q branches. If a correlation is made between the bands of the solution and vapour on the basis of the absence of a vapour-to-solution shift, then for each band the P branch is strong, the Q branch is weak and the R branch is absent. If the correlation is made so that bands in the solution are regarded as shifted toward longer wave-lengths, it is found that (1) the branches of any one band are shifted by the same amount on a wave-number scale, (2) the shift varies from band to band (the shifts lie between 76 and 156 cm^{-1}.), and (3) Q branches are strongest, R branches are weak, and in every case the P branch is missing. Under either correlation the structure in each band indicates that the molecule in the solution is freely rotating. A. H.

3590. Absorption Spectrum of Chlorine Trioxide and Chlorine Hexoxide. C. F. Goodeve and F. D. Richardson. *Faraday Soc., Trans.* 33. *pp.* 453–457, *March*, 1937.—Chlorine trioxide in the vapour phase has been found to absorb in the ultra-violet with a threshold at about 3500 Å and two maxima at 2760 Å and about 2000 Å respectively. Liquid chlorine hexoxide was investigated by means of a special quartz wedge cell and found to absorb strongly from about 6000 Å throughout the whole of the spectrum to the limit of the spectrograph, 2200 Å. AUTHORS.

3591. Absorption Spectrum of P_2Se_5 Vapour. M. I. Haq and R. Samuel. *Indian Acad. Sci., Proc.* 5*A*. *pp.* 423–424, *May*, 1937.—One maximum of selective absorption at 2780 Å, and the beginning of a second, are observed in the spectrum of P_2Se_5. The energy difference of the long wave-length limits is 1·3 V as compared with 1·18 V for $^1D - {}^3P$ of Se. The two absorption regions are attributed to dissociation processes producing Se(^{3}P) and Se(^{1}D). C. B. A.

3592. Absorption Spectra and Configuration of Complex Salts. H. Sueda. *Chem. Soc. Japan, Bull.* 12. *pp.* 188–198, *May*, 1937.—From the comparison of absorption curves given by nitroammine-cobaltic complex salts near 360 $m\mu$ the following assumption was deduced: the absorption band presented by complex salt solutions can be resolved into the elements (characteristic absorption) which are due to the pairs of co-ordinated groups situated in transposition in a complex radical, and these elements show an additive property in the same complex ion. On this view, $K[Co(NH_3)_2(NO_2)_4]$ (Erdemann's salt) should have a trans-configuration. This assumption may also be applied to the visible and u.v. absorptions given by aquo-chloro-ammine salts of Co and Cr. AUTHOR.

3593. Absorption of Se_2 in a Magnetic Field. S. Rouppert. *Comptes Rendus*, 204. *pp.* 1723–1725, *June* 7, 1937.—The absorption of Se_2 in a magnetic field of 24,400 gauss is examined. All the bands increase in intensity. The results are attributed to the existence of three intersecting upper states. H. G. C.

3594. Absorption of Light by Porphyrins. Part XI. A. Stern and M. Deželić. *Zeits. f. phys. Chem.* 179. *Abt.A.* 4. *pp.* 275–294, 1937.—Continuing previous work [see Abstract 1226 (1937)] the absorption spectra of dihydroxy chlorins are investigated. The effect of the two OH groups is small, and from the results obtained it is probable that the two isomeric dihydroxy compounds investigated have the same steric relationships as the corresponding parent compounds. The absorption spectra of dihydroxy porphyrins are also examined. It is concluded that in the formation of these compounds the oxidation occurs at the methin bridges and not in the β-positions of the nuclei of the porphin system. In acid solvents large differences are observed between the absorption spectra of dihydroxy porphyrins and the parent porphyrins. Finally the absorption spectrum of an artificial rhodin is found to be of the porphyrin type, while the verdin derived from it possesses a band in the visible but does not fluoresce. After months of standing, however, the verdin solution becomes fluorescent and develops a weak porphin spectrum. This indicates slow attainment of an equilibrium between rhodin and verdin. L. A. W.

3595. Absorption Spectra and Photochemistry of Polyatomic Molecules Containing Alkyl Radicals. Part IV. J. W. Linnett and H. W. Thompson. *Faraday Soc., Trans.* 33. *pp.* 501–507, *March*, 1937.—The photochemical decomposition of $Hg(CH_3)_2$ vapour by light of wave-length 2537 Å has been studied. The products are metallic Hg and a mixture of hydrocarbons of which ethane is by far the most predominant. The quantum efficiency of the decomposition is, within the limits of experimental error, unity. The facts are well explained by the hypothesis that the primary act is in general—$Hg(CH_3)_2 \rightarrow Hg + C_2H_6$, without the production of reaction chains, but a few free radicals produced by the less important processes: $Hg(CH_3)_2 \rightarrow$

$Hg + CH_3 + CH_3$, or $Hg(CH_3)_2 \rightarrow Hg(CH_3) + CH_3$, may give rise to chains and to subsidiary hydrocarbon products. [For Part III see Abstract 3674 (1936).] AUTHORS.

3596. Absorption Spectra and Photochemistry of Polyatomic Molecules Containing Alkyl Radicals. Part V. H. W. Thompson and J. W. Linnett. *Roy. Soc., Proc.* 160*A*. *pp.* 539–562, *June* 15, 1937.—The vibration frequencies of some metallic alkyl compounds have been considered in the light of different possible types of the molecular force field. It is shown that with $Zn(CH_3)_2$ and $Hg(CH_3)_2$ the valency force field is much more satisfactory than the central forcefield, and that experimental data are most consistent with an angle of 180° between the two valency bonds of the metallic atom in each case. Force constants for the linkages in these molecules have been calculated. The general formulæ for the normal vibration frequencies of molecules of the type of $Zn(C_2H_5)_2$ and $Hg(C_2H_5)_2$ have been obtained, and using probable values for the appropriate force constants, their numerical magnitudes and geometric properties have been determined. The calculated results agree very well with experimental data. The significance of some of the results found is discussed in connection with chemical problems. The results suggest that a consideration in different series of compounds of the variation of force constants of links, for stretching and bending respectively, may give indications of localisation of electrons or of electron drifts. [See preceding and following Abstracts.] AUTHORS.

3597. Absorption Spectra and Photochemistry of Polyatomic Molecules Containing Alkyl Radicals. Part VI. H. W. Thompson and J. W. Linnett. *Faraday Soc., Trans.* 33. *pp.* 874–880, *July*, 1937.—Measurements on the u.v. photolysis of $Hg(CH_3)_2$ vapour [see preceding Abstract] have been extended. The decomposition is studied at higher temperatures, and also in the presence of NO. At the higher temperatures the quantum yield, which is unity at room-temperatures, rises to greater values. In the presence of NO, a solid product is formed, but the quantum yield of the disappearance of $Hg(CH_3)_2$ is still unity. All the facts are well explained on the basis of a scheme of elementary processes, and an estimate of the energy of activation of the reaction of a methyl radical with metal alkyl molecules suggests about 11,000 cal. It appears that perhaps one free radical disappears for each molecule of NO in the presence of the latter substance, and suggestions are given to account for this. AUTHORS.

3598. Structure of the *α* and *β* Band Systems of SiF. E. H. Eyster. *Phys. Rev.* 51. *pp.* 1078–1086, *June* 15, 1937.—A new vibrational analysis of the *α* system of SiF is presented. The rotational structure of the (0, 0) band of this system is analysed, giving $B_0'' = 0{\cdot}5795$ and $B_0' = 0{\cdot}5743$, and confirming the nature of the transition to be $^2\Pi_{\text{reg.}} \rightarrow {}^2\Pi_{\text{reg.}}$, with the upper state extremely near to case *b* and the lower state near case *a*. The doublet separation in the lower state is determined, but the spin doubling in the upper state is found too small to be accurately evaluated. The Λ type doubling is discussed. The rotational structure of the (0, 0) band of the *β* system is also analysed, and the transition confirmed to be of the type $^2\Sigma \rightarrow {}^2\Pi_{\text{reg.}}$, the $^2\Pi$ state being the lower state in the *α* system. For the $^2\Sigma$ state $B_0 = 0{\cdot}622$ is obtained, being less accurate than the values for the other two states because of experimental difficulties encountered in photographing this band. The spin doubling in the $^2\Sigma$ state is discussed, and the constants of the known electronic states of SiF are summarised. AUTHOR.

3599. Vibration-Rotation Interaction. Jenny E. Rosenthal and L. Motz. *Nat. Acad. Sci., Proc.* 23. *pp.* 259–265, *May*, 1937.—A new mathematical method, which makes an exact treatment possible, is applied to the problem of vibration-rotation interaction. C. B. A.

3600. Electronic States of Polyatomic Molecules. M. Kotani. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 460–470, *May*, 1937. *In English.*—The determination of the number of group-theoretically possible electronic terms of any given symmetry type and multiplicity, as carried out by Wigner and Witmer for diatomic molecules, is now made for a symmetrical polyatomic molecule. C. B. A.

3601. Valence Theory of the Methane Molecule. M. Kotani and M. Siga. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 471–486, *May*, 1937. *In English.*—The normal state of the CH_4 molecule is investigated without assuming electron pairing, but taking account of $(2s)^2\,(2p)^2$, $(2s)\,(2p)^3$ and $(2p)^4$ configurations of the C atom. C. B. A.

3602. Frequencies and Modes of Vibration of the Monodeuteroethylene Molecule. G. Lemaître, C. Manneback and Y. L. Tchang. *Ann. Soc. Sci. de Bruxelles*, 57. *pp.* 120–128, *June* 7, 1937. —The investigation of the effect of symmetrical substitution in C_2H_4 of two D atoms is extended to the unsymmetrical mono-derivative, and the frequencies and modes of vibration of C_2H_3D are tabulated. C. B. A.

3603. Stability of Polyatomic Molecules in Degenerate Electronic States. Part I. Orbital Degeneracy. H. A. Jahn and E. Teller. *Roy. Soc., Proc.* 161*A*. *pp.* 220–235, *July* 15, 1937.—It is shown that orbital electronic degeneracy and stability of the nuclear configuration are incompatible unless all the atoms of a molecule lie on a straight line. The proof is based on group theory and is therefore valid only if accidental degeneracy is disregarded. If the electrons causing the degeneracy are not essential for molecular binding only a slight instability will result. Table I (in the original), which is needed to prove the theorem, can also be used to obtain the number of proper vibrations of a given symmetry type for any polyatomic molecule. AUTHORS.

3604. Determination of Constants of Harmonic Vibrations. O. Redlich and H. Tompa. *J. Chem. Phys.* 5. *pp.* 529–538, *July*, 1937. —A general method is developed to find the relations between constants of the potential energy and the frequencies of point systems for harmonic vibrations. Useful formulæ are derived and matrices required frequently for the solution of problems are tabulated. Relations are also found between the force constants of a molecule with a number of equivalent atoms and the vibration frequencies of an isotopic molecule of a lower degree of symmetry. This also gives the relations between the frequencies of isotopic molecules of different degrees of symmetry. AUTHORS.

3605. Law of Emission of Continuous Spectrum from Xenon Tubes. M. Laporte. *Comptes Rendus*, 204. *pp.* 1559–1560, *May* 24, 1937.—The intensity of the continuous spectrum emitted by Xe tubes [see Abstract 3076 (1937)] is shown to be independent of the direction of observation. The gas therefore does not absorb its own radiations appreciably. C. B. A.

3606. Absorption Spectra of Solutions of Halides and Oxyhalides of S, Se and Te. R. Samuel and M. Usman. *Indian Acad. Sci., Proc.* 5*A*. *pp.* 425–432, *May*, 1937.—Halides and oxyhalides of S, Se and Te easily decompose; hence it has been thought advisable to measure the absorption spectra of these substances when dissolved in neutral solvents, hexane, ether and CCl_4 being used. As source the H continuum was used. The maxima already found for the vapour state are all present, whence it is concluded that these were actually due to the undecomposed compounds. A. H.

3607. Continuous Band with Intensity Fluctuations in the Fluorescence Spectrum of Cd-Vapour. A. Kotecki. *Acta Physica Polonica,* 6. 1. *pp.* 75–88, 1937. *In German.*—Saturated Cd vapour is excited by radiation from a hydrogen lamp filtered with uviol glass. A continuous fluorescence band with intensity fluctuations is obtained at 2700–2900 Å, corresponding with the known absorption at these wavelengths. This band originates in the overlapping of two band series, and cannot be attributed to a transition between two potential curves. An alternative explanation is given. C. B. A.

3608. Raman Spectra and Allied Physical Properties of Essential and Vegetable Oils. C. Dakshinamurti. *Indian Acad. Sci., Proc.* 5*A. pp.* 385–406, *May,* 1937.—The adiabatic compressibility, rate of variation of specific volume with temperature, specific heat at constant pressure, rotation of plane of polarisation, refractive index, depolarisation factor and the intensity of scattered light have been measured for 9 essential oils. From these data the isothermal compressibility and the ratio of specific heats are calculated for each oil with the help of thermodynamical equations. A piezometer similar to that described by Tyrer has been used for the compressibility measurements. A modified type of pyknometer has been used for the measurement of specific volumes. A spectrographic method is employed for the measurement of the intensity of the scattered light. For determining the other physical constants, usual methods have been adopted. A comparison is made of the observed intensity of light-scattering with that calculated on the basis of the above physical constants. Good agreement is noted in most cases thus furnishing a support for the theory of light scattering. Raman spectra of five of the oils, have been photographed using a two-prism glass spectrograph.

3609. Raman Spectra of Ketones. Dinah Biquard. *Comptes Rendus,* 204. *pp.* 1721–1723, *June* 7, 1937.—The Raman spectra were excited by a Hg lamp. The frequency due to $C = O$ is constant for aliphatic ketones. In ketones with a 5-C ring the frequency is increased, in those with 6- and 7-C rings it is decreased. H. G. C.

3610. Raman Frequencies and Interatomic Distances. P. Donzelot and J. Barriol. *Comptes Rendus,* 204. *pp.* 1867–1868, *June* 21, 1937.—A linear relationship $n = 3375 . 10^8 \ (1{\cdot}86 . 10^{-8} - r)$ is obtained between the " reduced " Raman frequencies n (in wave-numbers) and the interatomic distances r (in cm.) in polyatomic molecules. C. B. A.

3611. Raman Effect and Dipole Moment in Relation to Free Rotation. Part VII. Y. Morino and S. Mizushima. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 706. *pp.* 33–43, *June,* 1937. *In English.*—The theoretically-deduced fact that the force constant of a bond resonating equally between a single and a double bond is appreciably different from that for an ordinary double bond is tested by an experimental investigation of HCO_2H and the HCO_2' ion. The disappearance of the carbonyl frequency when a fatty acid is ionised is attributed to a change in bond character caused by quantum-mechanical resonance.

The value of the force constant of C-O in the CO_3'' ion is found to be greater than that expected on the assumption that it has a one-third double bond character. This can be explained by taking into consideration the effect of cross terms on the potential function. The observation of Zahn that the electric moments of some carboxylic acids and esters remain constant over a wide range of temperature is attributed to the rigid nature of bonds resulting from single-double bond resonance. Reasons are advanced for believing that such substances exist predominantly in one of the two possible alternative stable configurations which result from the rigid nature of the bond. [See Abstracts 2621 and 3133 (1937).] W. R. A.

3612. Dipole Moment and Raman Effect of Molecules with Free Rotating Groups. S. Mizushima, Y. Morino and M. Kubo. *Phys. Zeits.* 38. *pp.* 459–462, *June* 15, 1937.—A further consideration of the Raman effect and dipole moments of a number of compounds containing groups capable of free rotation. Measurements have been made on halogen-substituted ethanes and on $CH_3 . OCH_2 , OCH_3$. Diethyl carbonate is shown to have a more rigid structure as a result of single-double bond resonance. [See also Abstract 449 (1935).] W. R. A.

3613. Raman Spectra of Crystal Powders. R. Ananthakrishnan. *Indian Acad. Sci., Proc.* 5*A*. *pp.* 447–462, *May*, 1937.—The paper gives a detailed account of (i) the Raman spectra of 11 crystalline nitrates, photographed by the technique of complementary filters. It is found that the results of earlier investigators are incomplete in the case of all the nitrates excepting $NaNO_3$. The frequencies of the $(NO_3)^-$ ion are recorded as three sharp lines 723 (2), 1069 (12) and 1385 (6), in the spectrum of crystalline $NaNO_3$. The corresponding frequencies of KNO_3 are 715 (2), 1050·5 (12), 1343 (3) and 1360 (3). The splitting of the nitrate frequency in the 1300 region in the spectrum of KNO_3 is noticed for the first time, and is ascribed to the fact that its crystal structure is different from that of $NaNO_3$. The spectra of the nitrates of bi- and tri-valent metals are characterised by extreme complexity, and a large number of frequencies are observed between 1100 and 1650 cm.$^{-1}$, many of which are broad and diffuse. (ii) The Raman spectra of the water of crystallisation of 14 hydrated crystals. The results vary very much from substance to substance. It can generally be stated that water of crystallisation gives rise to Raman frequencies between 3150 and 3650 cm.$^{-1}$ [See also Abstract 2134 (1937).]

3614. Spectrum Analysis of Pb, Sn and Co. R. Breckpot. *Ann. Soc. Sci. de Bruxelles*, 57. *pp.* 129–140, *June* 7, 1937.—Methods of measuring foreign metals in the three elements are given. An arc is passed between either metal electrodes or the oxide produced from the metal. In certain cases, chemical concentration of the impurities is necessary. Tables showing the line strengths for different concentrations of some of the impurities are given. H. G. C.

***3615. Spectroscopic Determination of Boron. R. K. Calfee and J. S. McHargue.** *Indust. and Engin. Chem.* (*Analytical Edition*), 9. *pp.* 288–290, *June* 15, 1937.—Polarising attachments and an oxygen-methane blast burner for the spectroscopic determination of B are described. Natural gas saturated with methyl borate in methyl alcohol is ignited in an oxygen blast to excite the spectrum. A standard solution on ignition and polarisation produces a reference spectrum in juxtaposition to the spectrum of the sample. The degree of rotation of the analysing plate are read on a scale in terms of p.p.m. of B in the solution upon matching the intensities of the spectra. Recommendations are given for the treatment of samples containing halides and large amounts of Na salts. Samples containing from 1 to 600 p.p.m. of B have been analysed.

AUTHORS.

See also Abstracts 3308, 3329, 3489, 3490, 3527, 3531, 3661, 3692.

VELOCITY OF LIGHT.

3616. Measurement of Velocity of Light. W. C. Anderson. *Rev. Sci. Instruments*, 8. *pp.* 239–247, *July*, 1937.—A method is described for measuring the velocity of light with a relatively short base line. A Kerr cell modulates a light beam at very high frequencies and a photoelectric cell is used for detection of the modulations. The modulated light beam is divided into two portions by means of a half-silvered mirror and the two parts sent over different optical paths. By noting the difference in path length required to produce a minimum of voltage in the tuned circuit of the photoelectric cell, and the frequency of modulation of the light, it is possible to measure the velocity of light with considerable precision. Modifications of this method are described and the theory developed. The mean result of a series of measurements involving 651 observations is given as 299,764 km/sec. ± 15 km/sec. in vacuum.

AUTHOR.

VISION.

3617. Rôle of Electrical, Photochemical and Diffusion Phenomena in Vision. L. S. Ornstein and J. F. Schouten. *K. Akad. Amsterdam, Proc.* 40.3. *pp.* 376–382, 1937. *English Abstract.*—The visual sensitivity of the retina at the fovea when another part of the retina is stimulated by a dazzling light was studied by making a binocular match between a brightness seen by the one eye exposed to the dazzling light and a brightness seen by the other eye screened from the dazzling light. The effect of dazzling lights exposed for different periods was examined. For short exposures the eye recovered rapidly but for long exposures there was a slow recovery. This difference is associated with the operation of photoelectric and photochemical processes in the retina. It is also found necessary to postulate diffusion of light in the retina. W. S. S.

3618. Apparent Frequency of Flicker. Y. le Grand. *Comptes Rendus*, 204. *pp.* 1590–1591, *May* 24, 1937.—The author observed that the apparent frequency of flicker of a test field whose brightness varies periodically is in certain conditions much less than the actual frequency of alternation. Thus a 7° field alternating 42 times per sec. between a brightness of 300 c./m^2. and zero brightness appeared, when fixated, to flicker with the same frequency as when the speed of alternation was 7 times per sec. The effect was even more pronounced with indirect vision of the test fields. Other allied phenomena are also described. W. S. S.

3619. Instantaneous Threshold after Light Adaptation. S. Hecht. *Nat. Acad. Sci., Proc.* 23. *pp.* 227–233, *April*, 1937.—The author takes Blanchard's data for the brightness threshold of a 5° centrally fixated area determined "immediately" after extinguishing an adapting brightness of variable brightness and colour and plots the logarithm of the brightness threshold against the logarithm of the adapting brightness for each colour. All the curves show a change of slope for an adapting brightness in the region between 0·01 and 1 millilambert, the change being most pronounced for blue and least for red light. The high and low brightness ranges of the curves are associated respectively with cone and rod vision. Assuming both these types of vision to be mediated by simple reversible photochemical reactions, and assuming the threshold to be proportional to the initial velocity of the photochemical reaction after the removal of the adapting brightness, the apparent orders of the reactions for rod and cone vision are determined which best fit Blanchard's data. W. S. S.

3620. Foveal Light Adaptation Process. W. D. Wright. *Roy. Soc., Proc.* 122*B*. *pp*. 220–245, *April*, 1937.—The author presents further results and conclusions from his work on the recovery of the eye after adaptation to different colours and intensities. As before, the proportions in a trichromatic mixture viewed by the resting eye to give a binocular match with a monochromatic test spot viewed by the eye, which had previously been subjected to the given adaptation, were determined. The author interprets his results as suggesting that although the three reponse paths of the Young-Hemlholtz theory are still required, there may be a general luminosity process followed by linkages between the yellow and blue processes and between the red and green, features strongly akin to Hering's and other theories. The bearing of the results on heterochromatic photometry is discussed and application of the method for clinical purposes is suggested. W. S. S.

3621. Saturation-Discrimination of Two Trichromats. W. D. Wright and F. H. G. Pitt. *Phys. Soc., Proc.* 49. *pp*. 329–331, *July* 1, 1937.—Measurements have been made by the authors to determine the values for their own eyes of $\log (L_w + L_s)L_s$ for the just-noticeable first step from white for a range of spectral colours. [See also Abstract 1173 (1935) and following Abstract]. AUTHORS.

3622. Colour Vision Characteristics of a Trichromat. J. H. Nelson. *Phys. Soc., Proc.* 49. *pp*. 332–337 ; *Disc.*, 337, *July* 1, 1937.—The author's luminosity curve, trichromatic coefficients, mixture curves, curves, complementary wave-lengths and their mixture in terms of luminosity, and the hue-and-saturation-discrimination curves have been obtained and the results tabulated. [See preceding Abstract]. AUTHOR.

3623. Effect of a Glaring Light Source on Extrafoveal Vision. W. S. Stiles and B. H. Crawford. *Roy. Soc., Proc.* 122*B*. *pp*. 255–280, *April*, 1937.—The authors measure the effect of a glaring light on the threshold of vision for a test spot appearing at a point in the field of view separated from the direction of vision by an angle 5°, 10°, 24° or 50° approx. They find that in general the effect of the glaring light depends only on its angular separation θ from the test object and on the illumination E it produces at the eye. No anomaly is observed when the image of the glaring light falls on the fovea or on the blind spot. It is found that, as for foveal vision, the uniform field brightness which will produce the same increase in the threshold as the glaring light can be represented by the expression kE/θ^2 where, however, the constant k has a value somewhat greater than that found for foveal vision. W. S. S.

3624. Luminous Efficiency of Monochromatic Rays Entering the Eye Pupil at Different Points and a New Colour Effect. W. S. Stiles. *Roy. Soc., Proc.* 123*B*. *pp*. 90–118, *June*, 1937.—Measurements were made for monochromatic light of the change in apparent brightness of a test patch viewed by foveal vision as the point of entry of the rays in the eye is traversed across the eye pupil. The effort was found to be greatest for blue light and least for light at or near the yellow. In addition to the change in apparent brightness the colour of the test patch was observed to change as the point of entry was varied. For light of wave-length 578μ the colour difference between rays entering the pupil centrally and rays entering 3·5 mm. to the side was found to correspond to a shift in wave-length of approximately 10 *mμ*. Measurements of the hue change throughout the spectrum are reported. Possible theoretical implications of the phenomenon are discussed. W. S. S.

3625. Spatial Perception during Vision with a Steady View of Space. N. Günther. *Zeits. f. Instrumentenk.* 57. *pp.* 239–244, *June*, 1937.—Helmholtz considered that the shape of the space obtained with a stereoscope was true but diminished in size. Grützner considered it was dependent on the degree of convergence. A simple means to set free the experimental conditions from this factor of uncertainty is by the use of a flat boundary whose dimension is zero in the line of vision. If the true distance of a point in space is E, while through the stereoscope it is E', the difference of value $\Delta e'$, and the distance of the point of convergence of the line of sight E_k then $\Delta e' = A \cdot \Delta e_k$. Helmholtz gave $A = 1$ but Grützner gave a rough mean value of 0·041. Experiments are described and discussed to investigate this difference. R. S. R.

See also Abstracts 3520, 3571.

X-RAYS.

3626. Focusing of Electrons in an X-Ray Tube. N. C. Beese. *Rev. Sci. Instruments*, 8. *pp.* 258–262, *July*, 1937.—A theory is proposed that accounts for the variations in the observed focal spot patterns on the anodes of X-ray tubes caused by changes in the geometry of the kathode structures. The focusing of electrons emitted by a helical filament within a focal cup can be explained qualitatively by elementary electrostatics. Data are presented to show the variations in size and energy distribution within the focal spots when changes are made in the dimensions of the focal cup mouth, throat, filament diameter and the mounting depth of the filament in the trough of the focal cup. AUTHOR.

***3627. Absorption Coefficients for Al, Cu and Ag in the X-Ray Region from 13 to 24 Å. R. D. Hill.** *Roy. Soc., Proc.* 161*A*. *pp.* 284–298, *July* 15, 1937.—A description is given of the apparatus and method used for determining absorption coefficients in the long wave-length X-ray region. The homogeneous radiations were isolated by means of a plane grating spectrometer. X-ray intensities were measured photographically and calibration of the photographic emulsion was made using a rotating sector. The intensity-density curves for the wave-lengths 13·3, 14·6, 17·6 and 23·7 Å have been obtained and found to exhibit marked degrees of curvature as compared with those generally found for radiations of the hard X-ray region. In the absorption measurements, so as to eliminate errors arising from inhomogeneity, the absorbing laminæ were mounted on a rotating wheel. The measured mass absorption coefficients are as follows: 13·3 Å: Al 2180, Ag 9920; 14·6 Å: Al 2290, Cu 2470, Ag 10,050; 17·6 Å: Al 3520, Cu 3770; 23·7 Å: Al 7330, Cu 6870. Determinations for Al and Ag were found to agree with the extrapolated values of Biermann, and a value was obtained for the Cu L absorption jump which is consistent with the empirical rule suggested by Jönsson. AUTHOR.

3628. Sensitivity Variation of X-Ray Photographic Films. W. H. George. *Phys. Soc., Proc.* 49. *pp.* 357–363, *July* 1, 1937.—An experimental study of the variation of sensitivity from place to place on an X-ray photographic film has been made, so that fluctuations of blackening, due to intensity-variation of the incident radiation, can be distinguished from those due to film sensitivity. Double-film exposures are made with the two sensitive surfaces in contact, and the processing is carried out in a simple mechanical apparatus so that the films move always with accelerated motion relative to the liquids. It is found that if X-ray photographic films are used with the technique described and are blackened until they transmit about half the incident light, then the variations of sensitivity are such as may lead to maximum deviations in the individual measurements of X-ray intensity of the order ± 6 per cent in single-film exposures or of ± 3 per cent in double-film exposures. The mean deviations are of the order ± 2 per cent. AUTHOR.

3629. Reflection of White X-Radiation by Quartz. Y. Cauchois, H. Hulubei and J. Weigle. *Helv. Phys. Acta,* 10. 2. *pp.* 218–224, 1937. *In French.*—Deals with the reflection of white radiation from a crystal of quartz cut to a radius of 40 cm. as used by Curie. The crystal is arranged so that diffraction of radiation in the region 0·12 to 0·135 Å may occur simultaneously from different planes. The observed effects and the proposed theory fit fairly well. W. H. G.

3630. Analysis of the Widths and Shapes of X-Ray Lines Reflected from Flat Powder Layers. G. W. Brindley. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 353–368, *April,* 1937.—A detailed theoretical investigation of the effect of disposition of X-ray source, specimen and photographic film upon the line-widths and shapes of diffractions obtained from flat powder specimens and an incident beam slightly divergent from a point source, is given and the results illustrated by numerical examples. The lines have an asymmetrical intensity distribution and the intensities fall rapidly to zero even for lines which are not sharply focused. Broadly focused lines tend to become flat-topped and at the same time the asymmetry becomes more pronounced. The line widths for diffractions outside the region of sharpest focus are the same for flat and cylindrical powder layers, but the cylindrical specimen gives more symmetrical lines. It is claimed that comparison of intensities of a group of diffractions is more easily carried out by the flat layer method, since by varying the conditions the peak intensities can be controlled. A. G. Q.

3631. Temperature Effect on Intensity of Reflection of X-Rays from Zinc Crystals. E. O. Wollan and G. G. Harvey. *Phys. Rev.* 51. *pp.* 1054–1061, *June* 15, 1937.—An experimental study is made of the intensity of X-rays reflected from powdered Zn crystals at room-temperature and at the temperature of liquid air. The atomic structure factors for the Zn atom are found to depend on the orientation of the particular planes from which the reflection occurs. The results would fit the hypothesis that the Zn atoms in the crystal scatter as if they were distorted from spherical symmetry by elongation along the *c* axis. The thermal calculations agree with the average value from specific heat data. W. H. G.

3632. Atomic Structure and Vibrations in Zn Crystals. G. E. M. Jauncey, W. A. Bruce and E. M. McNatt. *Phys. Rev.* 51. *pp.* 1062–1073, *June* 15, 1937.—The measurement of the diffuse scattering of X-rays from single crystals of Zn is extended to temperatures of 100°, 200°, 298°, 370°, and 550° K. The measurements are made at a scattering angle of 30° for orientations of 3° and 90°. It is shown that the surfaces of the crystals must be plane to 10^{-5} cm. for reliable measurement and a method of annealing and polishing the crystals without producing a Beilby layer is described. The characteristic temperatures associated with vibrations parallel and perpendicular to the principal axis are found. In agreement with Zener's theory the characteristic temperature for parallel vibrations decreases with rise of temperature, whereas that for perpendicular vibrations remains almost constant. The average characteristic temperature for vibrations in all directions is slightly greater than the characteristic temperature for specific heat in agreement with Zener's theory. The decrease of the characteristic temperature with temperature appears to begin when the r.m.s. displacement exceeds about 0·13 Å. In a further series of experiments conducted at room-temperature, X-ray scattering angles ranging from 15° to 40° are employed for orientations of 14° and 90°. The results show that the atomic structure factor (the effect of atomic vibrations having been removed) is a function of the orientation angle out to $\sin \theta/\lambda = 0 \cdot 6$, *i.e.*, the electron atmosphere of each atom in the Zn crystal is asymmetric. J. T.

3633. Effect of Temperature on the Reflection of X-Rays. M. Blackman. *Cambridge Phil. Soc., Proc.* 33. *pp.* 380–384, *July*, 1937.—Owing to the motion of the particles in a crystal the reflection of X-rays is dependent on the temperature. This dependence has been treated by Debye and Waller. An exact expression for the temperature factor for a cubic crystal is now obtained, and it is shown that the vibrational spectrum enters into the factor in a very simple way, so that the measurement of the reflecting power provides direct information about the properties of the vibrational spectrum. That part of the factor which depends on temperature is the same as the Debye-Waller expression, but the result is not the same for the part independent of temperature. The Debye-Waller formula does not hold, however, at low temperatures. C. J. B. C.

3634. Semi-Optical Lines in X-Ray Spectra. A. T. Maitra. *Indian Journ. Phys.* 11. *pp.* 77–89, *May*, 1937.—In this paper an attempt has been made to sort out some lines in the K, L, and M series of X-ray spectra which are somewhat different in character as regards their origin and have a peculiarity of their own. Such lines belonging to the K series are K_{β_1}, K_{β_2} and K_α; to the L series are L_α, L_{β_3}, L_{β_5}, L_{γ_2}, L_{γ_4}, & L_{γ_6} and to the M series are M_{α_1}, and $(M_{III} \leftarrow O_{IV})$, only for some particular elements in each of the series as mentioned in the paper. ν/R values of the final states of these lines have been shown to accord reasonably with those of the lines themselves. An attempt has, therefore, been made to bring out the analogy between the transitions of these lines with those of optical lines from the fact that a knocked out electron from an inner level of an atom goes to a vacant, partially vacant or optical level and then a transition from one of these levels gives rise to them. Hence the name "semi-optical." Experimental facts are put forward in support of the view adopted. AUTHOR.

3635. Lα Lines of Nickel Alloys. F. C. Chalklin and S. P. Hillson. *Phil. Mag.* 24. *pp.* 190–195, *July*, 1937.—An account of work carried out with a plane grating vacuum spectrograph using specimens in sheet form, soldered to a water-cooled Cu anode. The bombarding voltage was approximately 5 kV with specimens of Ni, Cu, two Ni-Cu alloys and Radiometal and Mumetal. First order spectra of the Nα line in Ni (14·55 Å) were studied, the dispersion being 1·40 Å/mm. Results are given and show that the mean difference for the 5 Cu-Ni plates was zero. E. H. W. B.

3636. Fine-Structure of Soft X-Ray Absorption Edges. Part I. Li, Mg, Ni and Cu. H. W. B. Skinner and J. E. Johnston. *Roy. Soc., Proc.* 161*A. pp.* 420–440, *Aug.* 3, 1937.—Methods are described for the determination of the X-ray absorption edge fine-structure of metals in the wave-length region 100–300 Å. As source of light, a vacuum spark between metal electrodes is used, and the line character of the spectrum makes it necessary to develop a technique of photographic photometry in order to interpret the absorption photographs in terms of variations of the absorption coefficient of the metal foils with the wave-length of the incident radiation. The fine-structure of the following metallic absorption edges is given in detail: Li K, Mg L_3, L_2 and L_1, Cu M_{23}, Ni M_{23}. In addition the structure of the Li K edge in LiOH has been investigated. Numerical data relating to these absorption edges are added. AUTHORS.

3637. New X-Ray Interference Phenomenon. M. Renninger. *Zeits. f. Physik*, 106. 3–4. *pp.* 141–176, 1937.—A new phenomenon is described which occurs most noticeably in the case of an X-ray reflection which is weak by reason of a low structure factor. In such a case, as the crystal is rotated in the reflecting position, a series of intensity maxima occurs. These enhanced reflections are due to the excitation of secondary reflections, and may be so close together in the case of short wave-length X-rays such as Mo-rays, that they completely mask the ordinary reflection from a given plane. This is the case with the (200) and (222) reflections of diamond. The new type of reflection is termed *Umwegreflexion* and permits a very simple method to be developed for the precise determination of lattice dimensions. In the case of diamond the lattice constant is found to be $3{\cdot}5594_8 \pm 0{\cdot}00010$ Å. J. T.

3638. Intensity Variation of L-Series X-Ray Lines with Tube Voltage. G. H. Bancroft. *Phys. Rev.* 52. *pp.* 6–11, *July* 1, 1937.—The variation of intensity of the L-series X-radiation, from a Cu target, with the voltage applied to the X-ray tube has been studied. The voltage range over which this investigation was made included the K-excitation value for Cu. A definite increase was found in the slope of the intensity-applied voltage curve, which appeared immediately after the K state was excited. The intensity was plotted against the square of the voltage difference between the K-excitation and the applied voltages, and the resulting curve was found to be substantially a straight line. This result is in accord with the theoretical predictions of Smekal and is an improvement over the experimental work of Stumpen. AUTHOR.

3639. Sharpness with X-Ray Intensifying Screens. G. Spiegler and G. Rudinger. *Zeits. f. techn. Physik*, 18. 6. *pp.* 164–167, 1937.—A "sharpness index" is defined for X-ray intensifying screens. The measurement of this index is based on the microphotometric comparison of images of a narrow slit obtained with and without intensifying screen. J. T.

See also **Abstracts 3318, 3343, 3344.**

HEAT.

CALORIMETRY.

***3640. Heat Capacities of Benzene, Methyl Alcohol and Glycerol at Very Low Temperatures. J. E. Ahlberg, E. R. Blanchard and W. O. Lundberg.** *J. Chem. Phys.* 5. *pp.* 539–551, *July*, 1937.—The design and operation of a low-temperature vacuum calorimeter which is internally cooled from 13° to 2° K. is described. The principle employed is that of adiabatically expanding cooled He from a small pressure chamber, located inside the calorimeter can. The heat capacities of crystalline benzene and methyl alcohol and crystalline and glassy glycerol have been measured down to 3° K. New values of the entropies of these substances at various temperatures have been calculated. Below 9° K. the heat capacity of glassy glycerol is 100% larger than that of crystalline glycerol. The glassy form apparently has 4·64 units of entropy at the absolute zero. AUTHORS.

3641. Electronic Activation in Crystals: Heat Capacities of $Sm_2(SO_4)_3 \cdot 8H_2O$ and $Nd_2(SO_4)_3 \cdot 8H_2O$ from 3 to 40° K. J. E. Ahlberg, E. R. Blanchard and W. O. Lundberg. *J. Chem. Phys.* 5. *pp.* 552–556, *July*, 1937.—The heat capacities of the sulphate octahydrates of Nd and Sm are measured from 3 to 40° K. The results are applied to the study of the electronic energy states of the rare earth ions. The electronic heat capacity of the Nd ion in the suphate octahydrate is determined. The separations of the two electronic energy levels comprising the basic states of both salts are found to be less than 1 cm.$^{-1}$. The presence of an electronic energy level in $Nd_2(SO_4)_3 \cdot 8H_2O$ at 77 cm^{-1}. above that of the basic state is substantiated. The statistical weight of this level appears to be twice that of the basic state. AUTHORS.

3642. Heat-Capacity and Electrical Resistance of Didymium between 300° and 600° C. F. M. Jaeger, J. A. Bottema and E. Rosenbohm. *K. Akad. Amsterdam, Proc.* 40. 6. *pp.* 481–489, 1937.—The heat-capacity of didymium at different temperatures was compared with that of Cu by the Saladin-le Chatelier method, and the various peculiarities of the curve are discussed. The variation of the resistance with temperature was obtained from measurements on a U-shaped piece of the metal and its resistance was so small that the change in resistance of the Cu leads with temperature had to be estimated and introduced. Difficulties, due to retardation phenomena were experienced in measuring the specific heat of didymium, and heating over periods of several weeks was necessary to obtain concordant results. The variation of the atomic heat with temperature is discussed, and it is concluded that, like Ce and La, didymium shows values of its atomic heat which even at moderate temperatures, appreciably surpass the theoretical limit of 3R cal. E. H. D.

3643. Heat-Capacities of Selenium Crystals, Selenium Glass, and Tellurium at Low Temperatures. C. T. Anderson. *Am. Chem. Soc., J.* 59. *pp.* 1036–1037, *June*, 1937.—The heat-capacities of Se crystals and Te from about 50 to 300° K. have been determined and their corresponding entropies calculated as 10·49, and 12·85, respectively. Measurements for Se glass over the same range indicate the difference in entropy from 0 to 298·1° for this material to be 11·15. AUTHOR.

3644. Heat Capacity and Entropy of Silver Nitrate. W. V. Smith, L. I. Brown and K. S. Pitzer. *Am. Chem. Soc., J.* 59. *pp.* 1213–1215, *July*, 1937.—The heat capacity of $AgNO_3$ is determined from 15 to 300° K, and the entropy of the salt at 298·1° K is found to be 33·68 e. u. The heat of solution in water and in dilute aqueous ammonia is measured at 298·1° K. The free energy of solution is calculated to be − 510 cal./mol., and the free energy of formation of the solid from its elements calculated to be − 7350 cal./mol. The entropy of aqueous silver ammonia complex ion is calculated to be 58·7 e. u. at 298·1° K. AUTHORS.

See also Abstracts 3361, 3608, 3669, 3670.

CONDUCTION.

3645. Operational Determination of Green's Functions in Theory of Heat Conduction. A. N. Lowan. *Phil. Mag.* 24. *pp.* 62–70, *July*, 1937.—A solution of the differential equation $dT/dt — K\Delta T$ satisfying the initial condition $\lim_{t=0} T(x, y, z, t) = f(x, y, z)$, and the boundary condition $\alpha\, dT/dt + \beta dT/dn + \gamma T = \gamma\phi(x, y, z, t)$ is derived by application of the Laplace operator and Borel's theorem. The Green's function, G, satisfies the boundary condition $\alpha dG/dt + \beta\delta G/\delta n + \gamma G = 0$ on the surface S. A method of deriving G in specific cases by the use of standard methods of operational calculus is discussed in the case of a semi-infinite solid extending from $x = 0$ to $x = \infty$, for the special case $\alpha = 0$. In such cases G satisfies the equation $\delta G/\delta t - \kappa\delta^2 G/\delta x^2 = 0$, and the boundary condition $\delta G/\delta x — hG = 0$ for $x = 0$ where $h = -\gamma/\beta$. J. S. G. T.

3646. Thermal and Electrical Conductivity of Acheson Graphite. R. W. Powell. *Phys. Soc., Proc.* 49. *pp.* 419–425; *Disc.*, 425–426, *July* 1, 1937.—Determinations have been made of both the thermal and the electrical conductivities of a sample of Acheson graphite over the temperature-range from 0° C. to 800° C. The thermal conductivity K is found to decrease from a value of 0·40 unit at 0° C. to 0·16 at 800° C., the rate of decrease being greater at lower temperatures. The electrical conductivity σ has at 0° C. a value of $1218\Omega^{-1}$. cm^{-1}., which increases to a maximum value of 1518 at 450° C. and decreases to 1444 at 800° C. The corresponding Lorenz function $K\sigma^{-1}T^{-1}$ has a value of 121×10^{-8} at 0° C., which is more than 200 times the value indicated by the electronic theory and possessed by most well-conducting metals. With increase in temperature the value of the Lorenz function decreases rapidly, its value being given by the equation $K\sigma^{-1}T^{-1} = 0{\cdot}0294T^{-1{\cdot}8}$. Thus the Wiedemann-Franz-Lorenz law does not hold for the present sample of graphite, but is replaced by the equation $K\sigma^{-1}T^{0{\cdot}8}$ = a constant. The power to which the absolute temperature is raised is different as well as the constant value of the expression. [See also Abstract 2279 (1936).]

AUTHOR.

3647. Exchange of Energy between a Platinum Surface and Helium Atoms. W. B. Mann. *Roy. Soc., Proc.* 161*A*. *pp.* 236–247, *July* 15, 1937.—In the course of experiments on the transfer of energy across a Pt-He interface it had been observed that the surface of a Pt wire was far more resistant to contamination after it had been heated in O_2. In the present research this effect is investigated, using the method of electron diffraction. It is found that a thin protective film is formed on the surface of the Pt, the film being composed of light and heavy atoms situated respectively at the body-centre and corner positions of a tetragonal lattice, the constants of which are $a = b = 5{\cdot}38$ Å and $c = 4{\cdot}43$ Å.

The chemical composition of this film is not known. The surface conditions are correlated with those in previous experiments by determination of the accommodation coefficients with respect to He. [See Abstract 777 (1935).] AUTHOR.

See also Abstracts 3579, 3707.

CONVECTION.

3648. Heat Transfer Equation for Fluid-Flow in Tubes. E. Hofmann. *Zeits. f. ges. Kälte-Ind.* 44. *pp.* 99–107, *June,* 1937.—The equation $\mathrm{Nu} = 0{\cdot}0395\ \mathrm{Re}^{\frac{3}{4}}\mathrm{Pr}/[1 + \mathrm{B}\ \mathrm{Re}^{-\frac{1}{8}}\ \mathrm{Pr}^{-\frac{1}{6}}(\mathrm{Pr} - 1)]$ is considered to represent the heat interchange between a fluid and the walls of the tube through which it is flowing more adequately than does the original Prandtl-ten Bosch equation. An analysis of all existing data indicates that B should have the value of 1·5. R. W. P.

3649. Equations for Thermal Diffusion in Turbulent Media. J. K. de Fériet. *Ann. Soc. Sci. de Bruxelles,* 57. *pp.* 67–72, *June* 7, 1937.—Atmospheric variations in temperature at high levels cannot be explained by the Fourier equations of thermal diffusion alone, since there is a considerable heat transfer by large-scale turbulent diffusion. The equation is derived for such turbulent diffusion in an incompressible fluid. R. W. P.

DILATATION.

3650. Expansion and Pressure Coefficients of Nitrogen, Hydrogen, Helium and Neon, and the Absolute Temperature of 0° C. M. Kinoshita and J. Oishi. *Phil. Mag.* 24. *pp.* 52–62, *July,* 1937.—Values of the expansion coefficient (α_N) and the pressure coefficient (β_N) of the respective gases between 0° C. and 100° C. reduced to $p_0 = 1$ m. of Hg have been determined as follows: N_2, $\alpha_N = 36729 \times 10^{-7}$, $\beta_N = 36745 \times 10^{-7}$; H_2, $\alpha_N = 36586 \times 10^{-7}$, $\beta_N = 36619 \times 10^{-7}$; He, $\alpha_N = 36580 \times 10^{-7}$, $\beta_N = 36604 \times 10^{-7}$; Ne, $\alpha_N = 36598 \times 10^{-7}$; $\beta_N = 36616 \times 10^{-7}$. Results for Ne were rather inconsistent. Taking the mean value of 20 results obtained with N_2, H_2 and He, the value of the absolute zero of temperature is found to be $-273{\cdot}16_7 \pm 0{\cdot}00_5$° C. J. S. G. T.

See also Abstracts 3421, 3608.

MELTING AND BOILING POINTS.

3651. Interpretation of Freezing Point Lowering Data in Terms of Polymerisation. E. N. Lassettre. *Am. Chem. Soc., J.* 59. *pp.* 1383–1387, *July,* 1937.—A method of calculating equilibrium constants of polymerisation reactions from freezing point, boiling point, and distribution data is described. The method is applied to various compounds and it is shown that the data are often fitted by the empirical relation $n = 1 + \alpha Q + \beta N$. The distribution of phenol between penta-chloroethane and water is accurately accounted for by the same type of equation as accounts for freezing point lowering data. AUTHOR.

3652. Melting Process of Mercury. A. Smits and G. J. Muller. *Zeits. f. phys. Chem.* 36. *Abt.B.* 4. *pp.* 288–290, 1937.—Data are communicated for the exact determination of the V, T-curve of the fusion process of a highly purified Hg preparation. The whole melting procedure took place within a temperature region of 0·024°, and the almost vertical part of the curve passed with rounding into the two other parts. This result shows that, although Hg belongs to those substances which may fairly easily be prepared to a high degree of purity, the melting process takes place in a temperature region which is comparable in magnitude with those found for the low temperature transformation of NH_4Cl and NH_4Br, viz.—0·010° to 0·025°. The purification of these salts has therefore been as thorough as for Hg, and the transformations described for the salts are just as certainly heterogeneous processes as the fusion of Hg. H. H. Ho.

3653. Electronic Net of Transition Elements. R. Forrer. *Comptes Rendus,* 204. *pp.* 1554–1556, *May* 24, 1937.—The formula $T = F\sqrt{N}$, where T is melting point, F ordinarily about 300° and N the number of electron "contacts," gives for the transition elements, Pt, etc., too high a value for N if only the *p* electrons are considered. Arguments are adduced in support of taking into consideration some of the (normally) *d* electrons, which in these elements are considered to be *s*. [See Abstract 2170 (1937).] C. A. S.

3654. Two Forms of Liquid Helium. M. Wolfke. *Acta Physica Polonica,* 6. 1. *pp.* 68–74, 1937. *In French.*—In conformity with a thermodynamic definition it is proposed that He II should be considered as a solid phase of He, and the point λ as the triple point corresponding to it. A thermodynamic discussion of the heat of transformation at this point is given. It is also shown that the dielectric polarisation of liquid He does not depend on temperature. Recent measurements give a value of 0·1253 cm³./gm. for this dielectric polarisation. Further measurements of the electric conductivity of liquid He show that it is a perfect insulator. A system of nomenclature for the different forms of He is suggested, the two solid forms being designated α and β. G. G.

3655. Wetting of Filaments by Molten Metals. M. A. Countryman. *J. of Applied Physics,* 8. *pp.* 432–433, *June,* 1937.—The specimen metal is initially in the form of thin wire wrapped round a filament of a metal of higher melting point. For successful evaporation *in vacuo* the molten metal must wet the filament and must not interact with it to form a low melting point alloy. Experimental data for Al, Ag, Au, Cu, Ni, Cr and Pt using filaments of Ni, Pt, Mo, Ta and W are given. A. G. Q.

***3656. Sulphur Boiling-Point Apparatus with Internal Electric Heating. C. R. Barber.** *Journ. Sci. Instruments,* 14. *pp.* 227–229, *July,* 1937.—A sulphur boiling-point apparatus suitable for calibrating thermocouples is described. It is constructed of pyrex glass and has a platinum heater completely immersed in the sulphur. The platinum leads to the heater are sealed directly through the pyrex below the surface of the sulphur. This method of heating reduces the risk of fracture of the container on remelting the sulphur. The boiling-point is realised to the accuracy of 0·1° C. AUTHOR.

See also Abstracts 3306, 3675.

TEMPERATURE, MEASUREMENT OF.

***3657. Reliability of Thermocouples. D. Quiggle, C. O. Tongberg and M. R. Fenske.** *Indust. and Engin. Chem.* 29. *pp.* 827–830, *July,* 1937.—The results obtained seem to indicate that for the temperature range, for the size of wires, and for the conditions under which the tests were made: (1) Heat treatment of copper-copel, copper-constantan, and chromel-alumel thermo-couples above about 200° C. causes them to indicate temperatures which are different from those before heat treatment, the discrepancy, in general, being greater the higher the temperature of heat treatment; moreover, measurements of lower temperatures show, in general, less discrepancy than measurements of higher temperatures. (2) Heat treatment of copper-copel and copper-constantan thermocouples at temperatures between about 300° C. and 300–350° C. causes them to indicate a higher temperature than before such heat treatment; heat treatment above 300–350° C. causes them to indicate a lower temperature. It may be concluded that copper-copel and copper-constantan thermocouples possess a rather high degree of reliability if used in the temperature range 0° to 200° C. AUTHORS.

***3658. New Optical Pyrometer. K. Guthmann.** *A.T.M. No.* 71. T57–T59, *May*, 1937.—Discusses the differences between true temperature, brightness temperature and colour temperature, and describes a new type of optical pyrometer in which both brightness and colour temperatures are measured, the results being then combined to give a reading of true temperature. In the second part of the paper a description is given of the results of pyrometer measurements applied to different problems in the determination of high temperatures (up to 2000° C.). The figures obtained by pyrometry are compared with those given by thermocouples. J. W. T. W.

***3659. A.C. Bridge in Laboratory Temperature Control. M. Benedict.** *Rev. Sci. Instruments*, 8. *pp.* 252–254, *July*, 1937.—An a.c. bridge and amplifier for continuous temperature control of furnaces and thermostats is described. The circuit is simple and portable and can be made from standard electrical equipment. The power output of the control circuit is doubled for a change of 0·03 % in resistance of the regular thermometer. Regulated power up to 550 W may be obtained. The control circuit has been used to maintain the temperatures of an oil bath and a furnace constant within 0·03° C./hr. AUTHOR.

See also Abstracts 3544, 3549, 3550, 3650, 3656, 3692.

THERMOCHEMISTRY.

3660. Heat of Formation of Hydrocarbons. M. Brutzcus. *Comptes Rendus*, 204. *pp.* 1802–1804, *June* 14, 1937.—The heats of formation from gaseous C and H_2 are calculated for the open chain hydrocarbons C_nH_m ($m = 2n + 2$, $2n$, and $2n - 2$), and also for the cyclic hydrocarbons with $m = 2n$, $2n - 2$, and $2n - 6$), together with the calorific values of the valencies. [See Abstract 2177 (1937)]. C. A. S.

3661. Energy of Dissociation of CO. R. Schmid and L. Gerö. *Zeits. f. phys. Chem.* 36. *Abt. B.* 2. *pp.* 105–128, 1937.—Spectroscopic data of various kinds relating to the dissociation of CO can be interpreted on the assumptions (i) $CO \rightarrow C(^5S) + O(^3P) - 11{\cdot}06$ V and (ii) $C(^5S) \rightarrow C(^3P) + 4{\cdot}17$ V. These are also in satisfactory agreement with the results of experiments upon electron impact in CO and CO_2, the heat of vaporisation of solid carbon, the dissociation of the CN molecule and the u.v. absorption spectra of CO and CO_2. L. A. W.

3662. Absolute Intensity of Electronic Radiation from the Flame of CO and O_2. H. Kondratjewa and V. Kondratjew. *Acta Physicochimica*, 6. 5. *pp.* 748–754, 1937. *In English.*—The absolute intensity of the electronic radiation of the flame of CO and O_2 has been measured photometrically in the visible and u.v. regions. The velocity of the reaction was also measured and by taking into account the quenching of the chemiluminescence it has been shown that at 100 mm. pressure and 740° C. one excited CO_2 molecule is formed in the flame zone per about 125 unexcited CO_2 molecules, it has also been shown that the concentration of CO_2' molecules is very much greater than the equilibrium concentration for the temperature of the flame, and it follows that these molecules are of chemical origin. [See also Abstract 3262 (1936)]. AUTHORS.

See also Abstract 3668.

THERMODYNAMICS.

3663. Second Virial Coefficient of Modifications of Light and Heavy Hydrogen. Part I. K. Schäfer. *Zeits. f. phys. Chem.* 36. *Abt. B.* 2. *pp.* 85–104, 1937.—This investigation continues the work of Clusius and Bartholomé [see Abstract 4797 (1936)] and is concerned with the measurement of the second virial coefficient of normal H_2 and D_2 in the temperature region between 20° and 46° K. Full experimental details are included: It is established that within this temperature range, the virial coefficient of D_2 is 15 to 20 % greater than that of H_2. Further measurement of the second virial coefficients of para-H_2 and ortho-D_2 indicate that between the virial coefficients of normal H_2 and para-D_2 and of normal D_2 and ortho-D_2, no difference could be established with the instruments available (of accuracy 1 cm.^{3}/Mol.). The results of some measurements of the second virial coefficients of CO_2, and C_2H_2 are also included. H. H. Ho.

3664. Mechanical-Chemical Constants of Benzene Hydrocarbons. G. Duch. *Comptes Rendus*, 204. *pp.* 1807–1809, *June* 14, 1937.—The author has previously shown [see Abstract 4038 (1936)] that at the temperature of the boiling point under the pressure of 74·5 cm. of Hg the law of attraction of two molecular liquid granules is $F = k^n m^2 Di^{-n}$ This law has now been verified for benzene, toluene, and the *o*–, *m*– and *p*-xylenes, and from the vaporation curves of these liquids in the *p*, *t* plane, it is found that the isodynamic points lie on an isobar parallel to the temperature axis. The experimental study of the mechanical-chemical constants *n* and k^{-3} has shown them to be linear functions of the vapour pressures. Data are given for the above hydrocarbons, and the formula deduced that M (the molecular weight) $= (k^{-3}D^{n+1}/A^3)^{1/(n-3)}$ where A and D are the surface tension and density respectively. H. H. Ho.

3665. Equilibrium Isotherms and Isobars of Binary Mixtures above the Critical Points of their Components. V. Fischer. *Ann. d. Physik*, 29. 6. *pp.* 514–526, *July*, 1937.—A relationship between the space content of liquid and vapour mixtures has been derived when a molecular concentration of the vapour attains an extreme value for the equilbrium isotherm. It is shown by an example from the $\bar{v}$, x-diagram of a mixture of methane and propane how this relationship can serve for the testing of measured volume data of mixtures. Analogous relationships were found for the equilibrium isobars both for the thermal content and for the entropies of mixtures, and corresponding expressions for mixture contractions and heats of admixture. Finally equations have been derived for the calculation of equilibrium concentrations, and from these equations others have been deduced for the case where the temperatures and pressures of the pure components lie below their critical temperatures and pressures. H. H. Ho.

3666. Liquid State. W. Altar. *J. Chem. Phys.* 5. *pp.* 577–586, *July*, 1937.—A theory of holes in liquids is developed to account for the thermal and mechanical properties of the liquid state. The treatment is founded on the assumption that the thermal motion of the liquid is determined by the motion of its " surface," this surface, however, to be understood in a broader sense so as to include internal boundaries of which the liquid forms as many as its number of degrees of freedom will permit. An equation of state is obtained and applied to liquid A, and very close agreement with the empirical data is reached. [See also Abstract 297 (1937)]. AUTHOR.

3667. Partition Function for Liquid Mercury. J. F. Kincaid and H. Eyring. *J. Chem. Phys.* 5. *pp.* 587–596, *July*, 1937.—From a model for liquid Hg has been formulated a partition function of sufficient generality to give by means of the usual statistical mechanical equations the vapour pressure, the equation of state, the entropy of melting and the specific heats. The partition function involves four parameters characterising the particular substance concerned. Having chosen these parameters for Hg it is possible to calculate all the above properties from the melting point to the boiling point within experimental error except for a slight divergence of about 2 % (0·1 cal./mol./deg.) in the specific heat at the melting point. The van der Waals constants follow from the theory and when employed in his equation give satisfactory agreement between calculated and observed critical properties. The long liquid range, low melting point, and low viscosity of metals are all in agreement with the model in which it is assumed that in the liquid the kernels move independently of their valence electrons. AUTHORS.

3668. Energy and Entropy of Solution. R. P. Bell. *Faraday Soc., Trans.* 33. *pp.* 496–501, *March*, 1937.—It is shown on the basis of existing data for the solubility of gases that there is a linear relation between the energy and entropy of solution of different solutes in the same solvent. This result is compared and contrasted with the regularities found by Evans and Polanyi for solutions of solids, and an attempt is made to interpret the facts in terms of a statistical treatment of the intermolecular forces. AUTHOR.

3669. Entropy of Methane. A. Frank and K. Clusius. *Zeits. f. phys. Chem.* 36. *Abt. B.* 4. *pp.* 291–300, 1937.—From measurements of the molar heat, the heat of transformation and the heat of vaporisation of normal methane, CH_4, the entropy at the boiling point 111·5° A is 36·53 ± 0·10 Clausius, and the statistical value calculated from molecular data is 36·61. From observations on heavy or deutero-methane CD_4, it appears that this gas has two transformation points. No such duality can be round for normal methane. The equality of the entropy obtained by the two methods is discussed in the light of nuclear spin and other internal properties. E. H. D.

3670. Thermodynamic Properties of Ethane. B. H. Sage, D. C. Webster and W. N. Lacey. *Indust. and Engin. Chem.* 29. *pp.* 658–666, *June*, 1937.—Specific volumes, Joule-Thomson coefficients, and isochoric specific heats are determined for ethane. From these and other primary data, values of heat content and entropy are calculated for a series of temperatures from 70° to 250° F. and at pressures from atmospheric to 3500 lb./in^2. absolute. Several diagrams illustrate the thermodynamic behaviour of this material. AUTHORS.

3671. Thermodynamics of the Electric Field with Special Reference to Chemical Equilibrium. F. O. Koenig. *J. Phys. Chem.* **41.** *pp.* 597–619, *April,* 1937.—The general thermodynamic equations for dielectrics permeated by electric fields are extended to include the case of variable composition. The derivation is based on the elementary laws of the plane condenser. Chemical equilibrium is shown to depend upon a chemical potential, μ_i, as in ordinary systems. It is shown that for a "dielectric phase" (homogeneous mass of dielectric permeated by a uniform field) there exist three convenient sets of characteristic functions corresponding to three kinds of pressure measurement. The effect of the field upon chemical potential is considered. The chief laws of equilibrium in a non-uniform field are derived. Among the new results of physical interest are (1) explicit formulæ for the energy of a dielectric phase, (2) the equations of state and the law of mass action for perfect gases in the electric field, (3) thermodynamic proof of the existence of a concentration gradient at equilibrium in a non-uniform field, and (4) the extension of the Lippman electrostriction formula for perfect gases to mixtures. AUTHOR.

3672. Thermodynamics of Aqueous Potassium Chloride Solutions from E.M.F. Measurements. H. S. Harned and M. A. Cook. *Am. Chem. Soc., J.* **59.** *pp.* **1290–1292,** *July,* 1937.—Measurements of the e.m.f.s of the cells Ag–AgCl | KCl (*m*) | K_xHg | KCl (0·05) | AgCl–Ag are made from 0 to 40° inclusive at 5° intervals, varying the concentration from 0·1 to 4 *M*. From these data, the activity coefficient, relative partial molal heat content and the relative partial molal heat capacity of KCl are calculated. Activity coefficients are found to agree well with those obtained by other investigators and the heat data derived from the e.m.f.s were found to agree satisfactorily with the results obtained from calorimetric measurements. AUTHORS.

See also Abstracts 3640, 3643, 3644, 3654, 3673.

VAPOUR PRESSURE.

3673. Pressure Effect on Liquid-Vapour Equilibrium in Binary Systems. B. F. Dodge and R. H. Newton. *Indust. and Engin. Chem.* **29.** *pp.* 718–724, *June,* 1937.—The increased use of high pressures in chemical processes has created a need for methods of calculation for cases in which neither solutions nor gases can be assumed to be ideal. Rigorous general differential equations are developed, and that connecting pressure and the compositions of both phases of a binary liquid-vapour system in equilibrium at constant temperature, is evaluated for several special cases. These include the four liquid-vapour combinations possible between slightly soluble, or very soluble gases and non-volatile or volatile solvents. More extensive and accurate P.V.T. data on solutions are required to test the equations thoroughly, but from such as are available it seems that only in the simplest case of a slightly soluble gas and a non-volatile solvent is it possible to calculate the effect reasonably well. For this case at constant temperature, given the solubility at 1 atmos. and one higher pressure, that at 1000 atmos. can be predicted, while the order of solubility at other temperatures can be obtained. R. W. P.

3674. Vapour Pressures of Aqueous Solutions of Sodium Nitrate and Potassium Thiocyanate. J. N. Pearce and H. Hopson. *J. Phys. Chem.* **41.** *pp.* 535–538, *April,* 1937.—The vapour pressures of aqueous solutions of $NaNO_3$ and KCNS are determined at 25° C. The apparent and partial molal volumes of the salts in these solutions are calculated. AUTHORS.

3675. Vapour Pressure of Copper and Iron. A. L. Marshall, R. W. Dornte and F. J. Norton. *Am. Chem. Soc., J.* 59. *pp.* 1161–1166, *July,* 1937.—The rates of evaporation of Fe and Cu have been used to determine the vapour pressures. The accommodation coefficient for these two metals appears to be unity, which apparently establishes the validity of the Langmuir method. Direct determinations of the emissivities of Fe and Cu have been made in conjunction with the vapour pressure study. The values of ΔE_0° for Fe and Cu are 96,033 and 81,240 cal./gm. atom, respectively. These values are shown to be in agreement with previous reliable determinations. AUTHORS.

3676. Vapour Pressures and Activity Coefficients of Aqueous Solutions of Ammonium Chloride. J. N. Pearce and G. G. Pumplin. *Am. Chem. Soc., J.* 59. *pp.* 1219–1220, *July,* 1937.—The vapour pressure over aqueous solutions of NH_4Cl is lowered from 23·673 mm. at 0·1 M to 12·281 mm. at 7·3800 M (saturation). The activities of the solvent, the geometric mean activity coefficients of the solute, and the free energies of dilution are calculated from the vapour pressure data. The method employed does not give satisfactory results using $CuSO_4$. AUTHORS.

3677. Vapour Pressures of Saturated Solutions. W. W. Ewing. *Am. Chem. Soc., J.* 59. *pp.* 1293–1294, *July,* 1937.—The conclusion that a straight line is obtained when the logarithm of the vapour pressure of a saturated aqueous solution is plotted against the reciprocal of the absolute temperature, which is parallel to a corresponding straight line for water, is seriously in error in the case of such a favourable substance as KCl, and is grossly in error for $Ca(NO_3)_2$ and similar hydrated salts. AUTHOR.

3678. Vapour Pressures of Saturated Aqueous Solutions. W. A. West and A. W. C. Menzies. *Am. Chem. Soc., J.* 59. *pp.* 1294–1297, *July,* 1937.—The graph obtained on plotting the logarithms of the aqueous pressures of saturated solutions against reciprocal temperatures may show many types of slope, and extreme or even retroflex curvature. The slopes of such curves are interpreted by means of an equation suggested by Roozeboom, which is applied to experimental data which were lacking in his day. AUTHORS.

***3679. Determination of Low Vapour Pressures. K. C. D. Hickman, J. C. Hecker and N. D. Embree.** *Indust. and Engin. Chem.* (*Analytical Edition*) 9. *pp.* 264–267, *June* 15, 1937.—Two methods are described for determining the vapour pressures of substances over the range 0·001 to 4·0 mm., and the vapour pressures from 1 to 50 microns of Hg are determined for two vacuum pump fluids, two sterols, and a dye. AUTHORS.

See also Abstract 3367.

ACOUSTICS.

***3680. Generation of Powerful Sound Vibrations by Magnetostriction. E. P. Ostrovskij.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 14. 8. *pp.* 491–494, 1937. *In English.*—Vibrators were made of tubes of sheet anode nickel with a disc of the same diameter copper-soldered to the end to act as radiator. The tube was fixed in the neck of an inverted bottle from which the bottom had been cut off. The upper portion of the vibrator was immersed in the liquid which filled the bottle. The lower part of the tube was within an a.c. magnetising coil, and permanent magnetisation was also applied to the tube to work it in the most favourable region of the magnetostriction curve. The tube was water-cooled to maintain the intensity of the vibrations and the natural frequency of the vibrator. Strong vibrations of frequency 10,000 produce a considerable emulsifying effect. Emulsions so obtained are more stable than those produced by piezo-quartz vibrators. The diameter of the oil particles was about 1 μ and less. Lead is strongly dispersed in water forming a sol of bluish tint. The loss of weight is 4·7 times that observed at high frequencies, with about $\frac{1}{10}$th of the power expenditure. The corrosion diminishes as the hardness of the metal employed increases.
G. E. A.

3681. Velocities of Sound in Solutions and Solutes. W. Schaaffs. *Zeits. f. Physik,* 105. 11–12. *pp.* 658–675, 1937.—After a series of measurements of the velocity of sound in simple and compound liquids an extrapolation process is developed for the characteristic sound lines of solutions which is fitted for determining the velocity of sound in dissolved substances. For the super-cooled liquid state this process was tested with two types of apparatus and found to be correct. The extrapolation procedure is then extended to solid substances. The few available numerical data indicate the usefulness of the new method for ascertaining the velocities of sound in substances and for states which for long have been scarcely attainable.
J. J. S.

3682. Visible Stationary Ultrasonic Waves in Liquids. Part II. O. Nomoto. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 337–365, *April,* 1937. *In German.*—The theoretical explanation of the first paper [see Abstract 5221 (1936)] is expanded, following a recent research of Pisharoty on the occurrence of periodic changes of amplitude in light waves of constant amplitude but with wave front of sine form. Visibility curves are calculated, taking into account the coherence relations of the components of each diffraction spectrum. These curves exhibit fine structure in cases of strong sound intensity. A modification of the method is described. The paper is well illustrated, and some of the reproductions of the bands show the fine structure plainly. The results are in agreement with theory.
G. E. A.

3683. Ultrasonic Diffraction of Light. Part II. R. C. Extermann. *Helv. Phys. Acta,* 10. 2. *pp.* 185–217, 1937. *In French.*—A continuation of theoretical work [see Abstract 5627 (1936)]. Here a quite general theoretical treatment is given for the diffraction of light by a medium which is periodic in one dimension. Numerical calculations have been made for some special cases and the treatment of complex examples is discussed. W. H. G.

3684. Speed of Ultrasonic Waves in Liquids by Means of Stationary Waves. R. Wyss. *Helv. Phys. Acta,* 10. 2. *pp.* 237–252, 1937. *In German.*—A comparison of the optical and electrical methods of investigating stationary ultrasonic waves brings out that the interference method with frequency modulation is the quickest and most reliable for measuring ultrasonic wave-lengths in liquids, even when these are strongly absorbent and optically turbid. The speeds were measured, for frequency 6000 kc./sec., for a number of alcohols and other organic liquids, for cane sugar solutions of varying concentration, and for CO_2-water (syphon) as dependent on time. G. E. A.

3685. Effect of Ultrasonic Waves on Metal Passivity. G. Schmid and L. Ehret. *Zeits. f. Elektrochem.* 43. *pp.* 408–415, *June,* 1937.—An account is given of investigations upon the effects of intense ultrasonic waves on the processes by which metals attain and lose passivity. It is found that passivity due to mechanical covering of the metal surface by a protective layer (*e.g.,* Fe in H_2SO_4 or the anodic polarisation of Pb in Na_2CO_3 solution) is prevented or hindered by ultrasonic waves, the protective layer being detached and dispersed in the liquid. On the other hand the anodic passivity of Al is favoured by ultrasonic waves, probably on account of forming of the metal surface. The fact that the anodic passivity of Fe in NaOH solution is not affected is taken as evidence that a protective layer must be absent in this case. The passivity of Fe and Cr in concentrated HNO_3 is hindered, but the anodic passivity of Ni in weakly acid Na_2SO_4 solution is favoured by the action of ultrasonic waves. L. A. W.

3686. Sound Transmission of Thin Single Walls. E. Lübcke and A. Eisenberg. *Zeits. f. techn. Physik,* 18. 6. *pp.* 170–174, 1937.—Measurement of the sound reduction of thin single walls as dependent on the frequency shows that both for porous and non-porous materials the curves obtained do not exhibit the rise with frequency to be expected from theory. The mean value of the sound reduction of such walls lies, moreover, below the so-called weight curve. The influence of porosity is negligible for the denser materials used in building construction. The discrepancies in the sound-reduction curves at high frequencies can be accounted for by partial resonances of the wall elements. A wall coated on one side with a porous material shows an increased sound reduction, probably on account of the additional air damping. With two walls separated by an air space a marked increase of sound reduction is observed, this being again attributable to the air damping in the space between the walls. [See also Abstract 1782 (1936).] A. W.

3687. Noise from a Swarm of Humming Insects. C. E. Guye. *Arch. des Sciences,* 19. *pp.* 53–70, *March–April,* 1937.—The problem is studied from the physical and physiological points of view. The acoustic pressure at the ear is discussed, and the number of "effective" insects is determined as $2\sqrt{N/\pi}$, where a swarm contains a very large number of 2N bees, wasps or flies. Expressions are calculated for the pressure-amplitude, the intensity of the acoustic pressure, and the ratio of the intensities when the number of insects alone is varied. Applying these results in conjunction with the threshold of audibility and Fechner's law, a minimum value of N is found for the general condition of audibility.

Three cases are considered, and, assuming a frequency of 100 for the hum of wasps, it is calculated that a swarm of 20,000 wasps will produce sounds of intensity 17, 37 and 57 db respectively according to the value of the intensity assumed for one wasp. In a second part is investigated the acoustic pressure at the centre of a spherical swarm. G. E. A.

3688. Structure of the Chromatic Scale. Rôle of the Seventh Harmonic. Renée Schidlof. *Arch. des Sciences,* 19. *pp.* 22–42, *Jan.–Feb.,* 1937.—The elements of acoustics relating to musical scales are recounted, and the octave is taken as the common unit in the formation of a scale. The octave is subdivided into intervals which are expressed in the form of frequency ratios or in terms of the savart. The number of savarts in an interval is found from 1000 log frequency ratio, and an octave contains 301·03 savarts. The methods which have been followed in forming musical scales are (*a*) a compromise between the natural and an artificial scale (Pythagorean and physicists' scales), and (*b*) an entirely artificial scale based on a simple arithmetical division of the octave (musicians' and tempered scales). The scales of Pythagoras, Aristoxene and Delezenne are discussed. The musicians' scale is virtually the Pythagorean, and all laboured under the disability that it was impossible to use them in musical transposition. The rational solution was found by J. S. Bach in the tempered scale. As regards the effort to achieve true intonation, it is pointed out that whereas organ and piano are tuned on the tempered scale, horn and trumpet use a scale of harmonics, and stringed instruments are tuned to fifths, so that musicians in general use the tempered, natural and Pythagorean scales. A theoretical scale is proposed for the use of physicists. The Pythagorean scale, based on multiples of 3/2 and 2, is expressed by the series: $N_2 = N_1 \cdot 2^{\alpha} \cdot 3^{\beta}$, where α and β are integers $\gtrless$ zero. The physicists' scale has another term, 5^{γ}. Adding the base 7 to this, the author calculates a new scale from $i = 2^{\alpha} \cdot 3^{\beta} \cdot 5^{\gamma} \cdot 7^{\delta}$, which brings in the 7th harmonic. The new scale is compared and tabulated with the other five. The last series was used first in acoustics by Euler. G. E. A.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

*3689. **Visual Balance-Detectors for Conductance Bridges. C. Morton.** *Faraday Soc., Trans.* 33. *pp.* 474–479, *March*, 1937.—A metal rectifier may be connected to a d.c. galvanometer in such a manner as to constitute a pointer a.c. balance-detector with the directional characteristic of the electrodynamometer; when used as a visual null-point detector in a conductance bridge, the direction of the deflection indicates the sense of the adjustment necessary to secure balance. The instrument has a wide frequency range, and is capable of detecting an alternating potential of 0·1 mV. A thermionic a.c. balance-detector with similar directional characteristics is also described. AUTHOR.

See also Abstract 3659.

CONDUCTION AND DISCHARGE IN GASES.

3690. Breakdown Voltage in Hg Vapour. R. Grigorovici. *Soc. Roumaine Phys., Bull.* 38. 68. *pp.* 7–15, 1937. *In German.*—Measurements have been made of the breakdown potential of Hg vapour between two plane, parallel iron electrodes, as a function of the gas pressure in the region 10 to 60 mm. Hg. Observations with increasing gas pressure gave a minimum striking voltage of 330 V, but when the observations were repeated with decreasing pressure the minimum voltage was 520 V. This is explained as the result of changes in the condition of the electrode surface, which has a marked effect on the breakdown voltage. The effect in this case is attributed to a thin Hg layer which lowers the breakdown potential at the minimum point of the curve by 150 to 200 V, and is destroyed after several successive discharges. J. E. R.

3691. Corona Discharge for D.C., Low and High Frequency, in Pure Nitrogen and Oxygen and their Mixtures. K. Lange. *Arch. f. Elektrot.* 31. *pp.* 411–416, *June* 15, 1937.—An experimental investigation was made of the effect on the incidence of corona discharges, of the high mobility of negative ions in an electropositive gas. In a pure electropositive gas at relatively high pressures the current is carried to a large extent by free electrons. This effect is hindered by an admixture of a small proportion of an electronegative gas. The influence of this on the current and voltage ratios of the corona discharge was investigated for d.c. and a.c. voltages, the latter of widely differing frequencies, in pure N_2 and O_2 and in definite percentage mixtures of these gases. It was found that in pure N_2 a strong negative current arises, similar to that with point electrodes, but that small admixtures of O_2 very rapidly reduce this effect, so that when the proportion of O_2 has reached about 1% the ordinary behaviour of the corona discharge in air is obtained. A. W.

3692. Spectrometric Determination of the Temperature in the Positive Column. T. Hamada. *E.T.J.* 1. *pp.* 57–60, *July*, 1937.—Observations were made along the axis of the positive column in the capillary of a discharge tube filled with N_2 and the rotational band spectra 3998 Å and 3914 Å were photographed with a grating. The intensity distribution in the bands was measured with a microphotometer and the temperature and the band energy were then computed from diagrams. The temperature was found to be a maximum on the axis of the tube and decreased towards the tube walls, the distribution curves approximating to parabolæ. From pressures of 3 mm. up to 30 mm. and from currents of 25 mA up to 175 mA the temperature (T) is approximately a linear function of the product of the pressure (p) and the current (i), the relation being $T = 0{\cdot}385\, pi + 850$, p being in mm., i in mA and T in °K. The band energy was found to be approximately proportional to the current through the discharge tube. A. W.

***3693. New Effect in the Argon Glow Discharge. K. Geiger.** *Zeits. f. Physik,* 106. 1–2. *pp.* 17–34, 1937.—The apparatus described consists of a discharge tube with a cylindrical anode surrounding a kathode made up of two identical circular plates on the cylinder axis, the distance between the plates being variable. The two parts of the kathode are separately mounted and can be raised to different potentials with respect to the anode. The current-voltage characteristics of an A discharge in this system are investigated and curves given. It is found that over a wide range of conditions the greater part of the total kathode current passes to the electrode which has the smaller p.d. from the anode. In the discussion of the effect it is shown that, as a result of the abnormal variations of the differential ionisation function for electrons in A in the voltage region considered, the ion density will be higher near the low potential part of the kathode, this part therefore taking the greater current. J. E. R.

3694. Dependence of Ignition Delay on the Potential. G. Hertz. *Zeits. f. Physik,* 106. 1–2. *pp.* 102–107, 1937.—On the basis of Townsend's theory of ignition phenomena calculations are made of the probability that an electron emitted from the kathode will give rise to ignition of a gas discharge. Braunbek has calculated this probability but his result is given in the form of an infinite series whose coefficients are somewhat troublesome to evaluate. A simpler solution is here given and is applied to obtain a curve showing the relation between the ignition probability and the potential for a discharge in A under certain conditions. A. W.

3695. Excitation of the C State of Hydrogen by Electron Impact. R. Roscoe. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 369–372, *April,* 1937.—The energy losses suffered by electrons in inelastic collision with H_2 molecules have been investigated experimentally, using a range of electron energies between 30 and 130 V, and the previous results of Jones and Whiddington confirmed. A calculation of the relative probabilities of transitions to the vibrational levels of the C state, by application of the Franck-Condon Principle, predicts a most probable energy loss which is 0·34 V in excess of the experimental value. A satisfactory explanation of the difference has not yet been found. AUTHOR.

3696. Townsend Ionisation Coefficient, α, for Neon-Argon Mixtures. A. A. Kruithof and F. M. Penning. *Physica,* 4. *pp.* 430–449, *June,* 1937. *In English.*—The ionisation coefficient $\eta = \alpha/E$ (E = electric field in V/cm.), has been determined for highly purified Ne and for 8 different mixtures of Ne and A. The apparatus used is an improved form of that described in an earlier paper [see Abstract 3809 (1936)]. In general the results confirm the form of variation of η with the percentage of A, determined previously from the starting voltages of luminescent discharges. The maximum value of $\eta(0{\cdot}037)$ is obtained with a mixture of Ne + 0·1 % A, when $E/p_0 = 3\text{V/cm.} \times \text{mm.}$ (p_0=gas pressure in mm. Hg reduced to 0° C.). When $E/p_0 < 1$ volt/cm. × mm., η falls rapidly as a result of, energy losses in the elastic collisions between electrons and gas atoms. For $E/p_0 < 60$ V/cm. × mm. the values for pure Ne are about 20 % less than those given by Townsend and MacCallum. Estimates are made of the factor γ (the number of supplementary electrons leaving the kathode as a result of a positive ion collision) and of V_δ, a correction to be made to the discharge starting voltage, calculated from α and γ. The appearance of "steps" in the curves of photoelectric current in Ne-A mixtures as a function of the anode potential is discussed and an explanation offered. [See following Abstract]. J. E. R.

3697. Townsend Ionisation Coefficient α and Some Elementary Processes in Neon-Argon Mixtures. A. A. Kruithof and M. J. Druyvesteyn. *Physica,* 4. *pp.* 450–463, *June,* 1937. *In English.*—From the Townsend ionisation coefficient α for Ne-A mixtures it is possible to calculate the probability χ that an excited Ne atom will produce an A ion during its life. This calculation is carried out by 2 different methods: (a) from the probability of the excitation of a Ne atom in collision with an electron; (b) from the results of measurements [see preceding Abstract] of the current n as a function of the anode potential. The variation of the probability χ with the percentage of A in the mixture when E/p is less than 3·5 V/cm. × mm., indicates that at least 90% of the Ne excitations result in a metastable atom. [See following Abstract.] J. E. R.

3698. Mobility of Electrons in Neon. M. J. Druyvesteyn. *Physica,* 4. *pp.* 464–466, *June,* 1937. *In English.*—Using the stationary velocity distribution of electrons in an electric field in Ne previously obtained [see preceding Abstract], the drift velocity is calculated. After using suitable approximations the calculations are found to be in good agreement with the experimental values of Bailey and of Nielsen. The best agreement is obtained if allowance is made for the effects of small quantities of impurities which result in ionisation by collisions of the second kind. J. E. R.

3699. Behaviour of Electrons in Bromine. J. E. Bailey, R. E. B. Makinson and J. M. Somerville. *Phil. Mag.* 24. *pp.* 177–190, *July,* 1937.—The methods developed by Bailey and Healey [see Abstract 2213 (1935)] for the study of the motion of electrons in Cl_2 have been applied to Br_2. The values in Br_2 of L the mean free path of an electron in the gas at 1 mm. pressure, λ the mean proportion of its own energy lost by an electron at a collision with a gas molecule, and h the probability of an electron becoming attached to the molecule with which it collides, are deduced and represented in terms of the velocity u of the electron, by means of curves. The following quantities for electrons in Br_2 are also deduced and represented in terms of Z/p by means of curves: W the drift velocity of an electron in the direction of the electric force Z, k the mean energy of agitation of an electron in terms of the mean energy of agitation of a molecule at 15° C., α/p the probability of attachment of an electron per unit length in the direction of the electric force with the gas at 1 mm. pressure. AUTHORS.

3700. Ion Reflection and Electron Emission by Bombardment of Metals with K^+ Ions. W. Veith. *Ann. d. Physik,* 29. 2. *pp.* 189–208, *May,* 1937.—Plates of Cu, Al and Pt were bombarded with slow K^+ ions (70–1140 V) and the velocity distributions of the secondary electrons produced and of the reflected ions investigated by the retarding field method. The effects of contact potentials, and of stray fields in the observation space were examined. Heating the reflecting plate increases the ion reflection and decreases the electron emission, but shows up more distinctly the electron velocity groups. Two groups of secondary electrons are found, (a) a very low velocity group (1 to 3 V) similar to those found in kathode-ray bombardment, the velocity being independent of the primary energy, (b) a higher velocity group extending over a narrow range. In the case of Pt these have energies between 16 and 19 V for 280 V primary ions, rising to 50 V for 1100 V ions. The velocity of this high energy group also varies with the metal, Al emitting faster electrons than Pt. The origin of the two groups of electrons is discussed in the light of the experimental results. Experiments on the reflected ions show that those coming from a Pt plate have almost their original velocity, but in the case of the Al reflector they do not reach such high speeds. J. E. R.

3701. Ionisation of Neon, Krypton and Xenon by Bombardment with Accelerated Neutral Argon Atoms. H. Wayland. *Phys. Rev.* 52. *pp.* 31–37, *July* 1, 1937.—A series of experiments on the ionisation of noble gases by accelerated noble gas atoms, with an electrometer method, is described. Preliminary measurements by Beeck showing little velocity dependence for ionisation of A by A atoms between 50 and 100 V, and showing an ionisation of Ne by A atoms in this energy range are shown to be due mostly to secondary effects—principally to A radiation. Positive evidence is given for the ionisation of one noble gas by atoms of another, and onset potentials for ionisation are found to be: 55 V for A bombarding Xe; 50 V for A bombarding Kr, and approximately 130 V for A bombarding Ne.

AUTHOR.

3702. Chemical Reactions in the Silent Electric Discharge. S. Miyamoto. *Chem. Soc. Japan, Bull.* 12. *pp.* 313–315, *June*, 1937. *In English.*—The chemical reactions under the silent electric discharge are studied when hydrogen reacts with the following inorganic solid substances.

Reacting substance	Reaction products
(1) Potassium chromate	Chromic oxide and potassium hydroxide.
(2) Potassium bichromate	Chromic oxide and potassium hydroxide.
(3) Ammonium chromate	Chromic oxide and ammonia gas
(4) Ammonium bichromate	Chromic oxide and ammonia gas
(5) Calcium chlorate	Calcium chloride.
(6) Sodium chlorate	Sodium chloride.
(7) Barium sulphite	Barium sulphide and hydrogen sulphide.
(8) Thorium nitrate	Thorium hydroxide, nitrite and ammonium salt.
(9) Ammonium persulphate	Sulphate and hydrogen sulphide.
(10) Potassium persulphate	Sulphate and hydrogen sulphide.

AUTHOR.

3703. Production of Light Ions by Molecular Jets. R. Planiol. *Comptes Rendus*, 204. *pp.* 1632–1633, *May* 31, 1937.—A current of H-ions exceeding 20 mA was obtained by a slight modification of that used for Cd [see Abstract 2826 (1936)]. Complete separation of protons and molecular ions has not yet been effected, but some progress has been made. The same method applied to N gave a current of N ions of 9 A. C. A. S.

***3704. D.C. Production at High Voltage. A. Piekara and J. Kryczkowski.** *Acta Physica Polonica*, 6. 1. *pp.* 89–93, 1937. *In French.*—Improvements are suggested on previous work [see Abstract 845 (1937.)], in that a larger current may now be obtained. An apparatus is described which possesses no moving parts but incorporates a thyratron whereby a d.c. potential may be tripled. A suitable transformer-diode circuit by means of which a d.c. potential of 220 V is raised to a d.c. potential of 10,000 V is also described. F. C. C.

***3705. H.V. Apparatus for Nuclear Disintegration Experiments. H. R. Crane.** *Phys. Rev.* 52. *pp.* 11–17, *July* 1, 1937.—A 10^6 V transformer and vacuum tube apparatus for nuclear disintegration work is described. The transformer consists of five 200,000-V sections, in a cascade circuit. The tube is made of five heavy pyrex glass sections 24 in. long and 16 in. in dia., with hollow steel electrodes 6 in. in dia. Each accelerating gap in the tube is connected across one of the sections of the transformer to insure uniform potential distribution. A focused ion beam of 250 μA is obtained at the target. Cloud chambers are operated in synchronism with this apparatus by means of a common contact system in such a way that both the ion source and the transformers are energised for only about ½ sec., during which the chamber expansion takes place. AUTHOR.

***3706. Proportional (Geiger-Klemperer) Counter. G. Brubaker and E. Pollard.** *Rev. Sci. Instruments*, 8. *pp.* 254–258, *July*, 1937.—A variety of different gases at different pressures have been introduced into a wire form proportional counter and the linearity of response over the entrance studied, It is found that this varies markedly with the nature and pressure of the gas, being very poor for gases which readily form negative ions and improving for almost all gases as the pressure is reduced. An incomplete explanation of the behaviour of the counter in terms for the formation of negative ions is given, which is useful as a qualitative guide. Suitable gases and pressures are recommended for various types of particle counting. AUTHORS.

See also Abstracts 3579, 3773.

CONDUCTION IN SOLIDS AND LIQUIDS.

3707. Second-Order Electrical Effects in Metals. A. H. Wilson. *Cambridge Phil. Soc., Proc.* 33. *pp.* 371–379, *July*, 1937.—A mathematical paper in which expressions are derived for the electrical and thermal conductivities and for the thermoelectric power at both high and low temperatures. The electrical effects at low temperatures present considerable difficulties, since a free path cannot be defined. C. J. B. C.

***3708. Rochelle Salt Electrometer. M. J. E. Golay.** *Rev. Sci. Instruments*, 8. *pp.* 228–230, *July*, 1937.—Rochelle salt electrometers may be used to advantage where space requirements demand a device of small size. They are useful if they are to operate in a high impedance circuit. They also serve to study conveniently the piezoelectric properties of Rochelle salt. AUTHOR.

3709. Effect of Heat on the Unipolar Electrical Conductivity of Carborundum. M. K. Chakravarty and S. R. Khastgir. *Phil. Mag.* 24. *pp.* 127–141, *July*, 1937.—The effect of temperature on the unipolar conductivity of carborundum is studied between 300° A and 800° A. It is found that the conductivity in either of the two opposite directions of the current-flow increases continuously with the rise of temperature in an exponential way, and that the ratio of the conductivities in the two opposite directions (which can be taken as a measure of volume rectification) increases in some cases and diminishes in some others with the increase of temperature. In some cases, again, there is a gradual rise followed by a decrease as the temperature is increased. The increase or decrease of the relative conductivity depends on the direction of the passage of the current through the crystal, and also on the specimen of the crystal itself. An interpretation of the experimental results is given in the light of Wilson-Fowler's electron theory of semi-conductors. It will be interesting if similar experiments to observe the effect of heat on volume rectification be carried out at very low temperatures. For very low as well as for very high temperatures the chief difficulty in these experiments is to keep the contacts between the crystal ends and the electrodes undisturbed. Within the range of temperatures (300° Å to 800° Å), however, it has been possible to keep these contacts intact. AUTHORS.

3710. New Induction Phenomenon in Supraconductors. P. Grassmann and H. Eicke. *Phys. Zeits.* 38. *pp.* 429–437, *June* 15, 1937. —This investigation relates to the flow within a supraconducting ring of induced continuous currents of almost the threshold value. It is found that when such a current is induced for the first time only a portion of the energy transmitted to the supraconductor can be accounted for by the continuous current. The remainder, which is generally of small amount, is absorbed in some other way by the conductor. The effect is not observed when a similar current is induced for a second or third time, but is twice as great if the current is induced to flow in the opposite direction. This absorption, which has been observed for a number of supraconducting metals, increases rapidly as the threshold value of the current is approached. It is considered that an explanation should be forthcoming on the lines of the theory of supraconductivity suggested by Stark. R. W. P.

3711. Practical Applications of Conductivity Measurements of Liquids. O. Dobenecker. *A.T.M. No.* 71. *T*60–*T*61, *May*, 1937.—The paper consists of a review of the various applications of measurements of electrical conductivity of solutions. The use of conductivity determinations in the chemical and applied industries, in waterworks, in the sugar industry and in the chemical laboratory as a means of obtaining information are pointed out and explained. F. J. B.

See also Abstracts **3345, 3362, 3363, 3364, 3382, 3563, 3642, 3646, 3654, 3689.**

DIELECTRICS AND CAPACITANCE.

3712. Dielectric Constants of Mixed Crystals of Sodium-Ammonium- and Sodium-Potassium-Tartrates. R. C. Evans. *Phil. Mag.* 24. *pp.* 70–79, *July*, 1937.—Measurements have been made of the dielectric constants at high frequencies of mixed crystals of Rochelle salt and ammonium sodium tartrate. It is found that as the proportion of the ammonium salt is increased the dielectric constant falls rapidly from a value of about 114 for Rochelle salt to a value of 8·2 for ammonium sodium tartrate. AUTHOR.

3713. Dielectric Constants of Gases and Vapours. M. Kubo. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 705. *pp.* 26–32, *June*, 1937. *In English.*—The dielectric constants of the vapours of allyl chloride and cyclohexene are measured and used to calculate the dipole moments and atomic polarisations for the molecules of these substances. The results obtained for allyl chloride are discussed with reference to its molecular structure, and the conclusion is arrived at that in unsaturated hydrocarbons the part of the molecule containing unsaturated bonds is the negative end of the electric moment vector of a small but finite magnitude. [See Abstract 869 (1937).] AUTHOR.

3714. Dielectric Constants of Ether-Chloroform and Ether-Chlorobenzene Mixtures. I. E. Coop. *Faraday Soc., Trans.* 33. *pp.* 583–590, *April*, 1937.—This work was carried out to obtain some idea of the extent of compound formation in the ether-chloroform system as other properties indicated that a compound existed to a considerable extent in equilibrium with the pure components. At low temperature it was considered that the anomalous behaviour would become more distinct. Quantitative estimations of the extent of the compound formed were not obtained but certain conclusions could be derived concerning the nature and structure of the compound. They indicated that the O atom of ether coordinates not with the halogen atoms but with the H atom of the chloroform. The possible nature of this new link is discussed. AUTHOR.

3715. Dipole Moments of Pyrone Derivatives. W. G. Wassiliew and J. K. Syrkin. *Acta Physicochimica*, 6. 5. *pp.* 639–660, 1937. *In German.*—In C_6H_6 solution the moments of γ-dimethyl pyrone, xanthone, and coumarin are 4·62, 2·94 and 4·54 D respectively. These values are much larger than the values obtained by vectorial addition of the values for individual polar groups. The discrepancies are explained by supposing that resonance exists between two molecular forms. W. R. A.

3716. Dipole Moments of Hydrazides. P. R. Frey and E. C. Gilbert. *Am. Chem. Soc., J.* 59. *pp.* 1344–1347, *July*, 1937.—The dipole moments of a series of seven hydrazides and related derivatives are determined and discussed. AUTHORS.

3717. Electric Strength and Dielectric Losses of Liquid Hydrocarbons with and without Dipole Character. R. Bredner. *Arch. f. Elektrot.* 31. *pp.* 351–371, *June* 15, 1937.—The liquids investigated were toluene, chlorobenzene, nitrobenzene and benzene. Nitrobenzene was also investigated in the solid state. After careful purification the electric strength of toluene between 10-mm. spheres with about 0·5-mm. gap width was found to be as high as 1500 kV/cm. Investigation with a.c. voltages of different wave form gave a dependence of the B.D.V. on the peak value, so that the breakdown could not be due to heat effects. This is in agreement with the fact that a reduction of the steepness of the voltage rise to 1/20th had no effect on the B.D.V. of toluene. The highest B.D.V. with toluene was obtained between chrome-steel spheres which had been scoured electrolytically. Tests with toluene and benzene showed that at 50~ the B.D.V. decreased to a marked extent with increased radius of the electrodes. The loss factors of these two liquids showed very great similarity, both in general behaviour and actual magnitude. Up to about 200 kV/cm. $\tan\delta \cong 2 \times 10^{-5}$. The B.D.V. of chlorobenzene and nitrobenzene was about one-half that of toluene and benzene, being about 700 kV/cm., and in their case there was definite evidence of the dependence of the B.D.V. on the effective value of the applied voltage, so that heat effects may arise with these liquids. This is in agreement with the observation that with nitrobenzene the B.D.V. falls when the steepness of the voltage rise is reduced. In all cases no dependence of the B.D.V. on the air pressure above the liquid was found. A. W.

See also Abstracts 3420, 3434, 3611, 3612, 3654, 3671, 3783.

ELECTROCHEMISTRY.

***3718. Saturated Standard Cells with Small Temperature Coefficients. W. C. Vosburgh, Mary Guagenty and W. J. Clayton.** *Am. Chem. Soc., J.* 59. *pp.* 1256–1258, *July,* 1937.—Substitution of Cd-Bi amalgam for the Cd amalgam of the Weston cell and saturation of the electrolyte with the double salt of Na_2SO_4 and $CdSO_4$ as well as with $CdSO_4$ gives a cell with an e.m.f. of 1·0184 V at 25° and a temperature coefficient of 0·000013 V/°C. AUTHORS.

3719. Value of the Microscopic Method for Studying the Structure of Electrolytic Deposits. P. Jacquet. *Comptes Rendus,* 204. *pp.* 1320–1322, *May* 3, 1937.—By means of a technique already described [see Abstract 1349 (1937)], the crystal structure of a number of thin deposits on a Cu kathode is examined. The microscopic structure of these deposits obtained by various current densities is described and a summary is given of the experimental evidence which shows that the intracrystalline structure of the base is of paramount importance as far as the crystal continuity of the surface layer is concerned. H. J. H. S.

***3720. Transport Numbers of Unsymmetrical Electrolytes and a Simplified Moving Boundary Apparatus. G. S. Hartley and G. W. Donaldson.** *Faraday Soc., Trans.* 33. *pp.* 457–469, *March,* 1937.—A simplified type of accurate moving boundary apparatus is described, and measurements on three unsymmetrical electrolytes are recorded. Conductivity measurements are carried out in very low concentrations of K_2SO_4, $K_3Fe(CN)_6$ and $Co(NH_3)_6Cl_3$, and the values of 80·8, 100·9 and 101·9 established for the infinite dilution conductivities of their multivalent ions at 25° C. The transport numbers of unsymmetrical electrolytes are shown to change with concentration, in low concentrations, in the direction predicted by the Onsager theory. Deviations from the theory occur with increase of concentration and in all cases in the sense that the actual change of transport number is less than the theory predicts. AUTHORS.

3721. Transport Numbers of Salts in Aqueous Solution at Higher Temperatures. C. S. Samis. *Faraday Soc., Trans.* 33. *pp.* 469–474, *March,* 1937.—Measurements are made of the transport numbers of aqueous solutions of KCl, $AgNO_3$, $ZnBr_2$ and $K_2C_2O_4$ at 40°, and HCl at 50°, by the moving boundary method. The transport number at infinite dilution for the K-ion in KCl at 40° is determined, and is 0·4913 ± 0·0003. The mobilities of a number of ions at 50° and the infinite dilution transport numbers for the above-mentioned salts are calculated. AUTHOR.

3722. Transference of Water. Part III. Its Dependence on Concentration in the Electrolysis of Barium Chloride Solutions. Millicent Taylor and Violet R. Willcox. *Chem. Soc., J. pp.* 902–907, *July,* 1937.—Transport measurements have been carried out at 25° in 0·5*M*- and 0·25*M*-solutions of $BaCl_2$ containing 0·1*M*-urea as non-electrolytic reference substance. The water transport per faraday is found to be from 1/4 to 1/8 of that which occurs in NaCl solutions of equal equivalent concentrations. In both concentrations the water transport is to the kathode. The Hittorf ionic transport numbers agree closely with those determined in the absence of urea by Jones and Dole. Both the Hittorf and true transport numbers of the Ba ion show large increase with increasing dilution. Notwithstanding this, the kathodic water transport does not increase with increasing dilution. It is therefore suggested that the double charge on the Ba ion produces a hydration shell which is more firmly bound and less sensitive to change in concentration than that round a Cl or a Na ion. Neither the water nor the ion transport values agree with the corresponding values determined by Baborovský and Viktorin. The divergence is ascribed to the use of a membrane by these investigators. [For Part II see Abstract 363 (1933).] AUTHORS.

3723. Energy States of Valency Electrons in Metals. M. Satô. *Tohoku Univ., Sci. Reports,* 25. *pp.* 829–878, *March,* 1937. *In English. Reports Nos.* 412 *and* 413 *of the Research Inst. for Iron, Steel, and other Metals.*—The experimental results of Straumanis [see Abstract 3295 (1930)] on the electrode potential of single Zn crystals are analysed and the potential values of the surfaces (0001), (10$\bar{1}$0), (11$\bar{2}$0), (10$\bar{1}$1), and (11$\bar{2}$1) for solutions of H_2SO_4 and $ZnSO_4$ are determined. A regularity and relation with the atomic spectrum of Zn is found and values are arranged in energy distances between two energy levels. With certain assumptions the absolute potential barriers on the surface of Zn single crystals are computed, and, combining these values with the electrode potentials, the absolute potential barrier on the H electrode is obtained. Comparing this with the molecular level values of H_2, determined through its band spectrum, it is found that the barrier is the level interval between H_2 and H_2^+. Data on the photoelectric behaviour of Mg with adsorbed films of H_2 are studied, and confirm that H is adsorbed on the metal surface in the state B, under the condition which is satisfied by the hydrogen electrode. Information on the mechanisms of adsorption and absorption of H_2 by metals is obtained from a review of the adsorption heats of H on W. From available data, the threshold over-potential of H on a Zn electrode is determined as 0·713 V. Addition of the normal electrode potential of Zn, 0·761 V., gives 1·474 V. which is taken as the threshold potential of the H on Zn electrode. From this and the hydrogen electrode potential barrier the potential barrier acting in the threshold state is determined as 2·68 V. This is in satisfactory agreement with the energy 2·51 e.V. required for the process $E_1 \rightarrow E_4$ (in the surface layer of the Zn electrode) combined with $H^+ + H \rightarrow H_2^+$ (in solution). [See also Abstract 1390 (1937).] N. M. B.

***3724. Reactions of Scandium at the Dropping Mercury Kathode. R. H. Leach and H. Terrey.** *Faraday Soc., Trans.* 33. *pp.* 480–486, *March,* 1937.—The determination of the deposition potential of scandium at the dropping mercury kathode is described with experimental detail. The value of the deposition potential is given as $-1 \cdot 84 \pm 0 \cdot 01$ V relative to the normal calomel electrode. It is shown that the polarographic method can be used for the qualitative and quantitative estimation of scandium. The conditions of the solutions and the limitations of the method are described, with particular reference to the simultaneous estimation of scandium and aluminium. A modified form of dropping mercury kathode is described. AUTHORS.

3725. Electrode Potentials of Platinum, Gold, and Silver. I. M. Kolthoff and Chin Wang. *J. Phys. Chem.* 41. *pp.* 539–544, *April,* 1937.—Au and Pt electrodes in solutions of $CuSO_4$ and $Cu(NO_3)_2$ behave as air electrodes. The potential is not affected by the concentration of Cu ions. After removal of air by N_2, the electrodes no longer behave as air electrodes. Apparently the oxidation potential of the Cu solutions is measured. Au and Pt electrodes in solutions of $AgNO_3$ of a concentration greater than 0·01 *M* indicate the oxidation potential of the Ag solution ($\mathrm{Ag}^+ + \varepsilon \rightleftharpoons \mathrm{Ag}$). The potentials are not affected, or only very slightly, by a change of the H-ion concentration or by the removal of O_2 by N_2. In all cases the noble metals are easily polarised and the systems are not suitable for exact measurements. AUTHORS.

***3726. Errors of the Glass Electrode. W. C. Gardiner and H. L. Sanders.** *Indust. and Engin. Chem.* (*Analytical Edition*). 9. *pp.* 274—278, *June* 15, 1937.—It has been found that at temperatures above 30° C. the glass electrode is not in agreement with the H_2 electrode, exhibiting deviations not only in the alkaline but also in the neutral and acid ranges. The magnitude of these deviations is greatly influenced by temperature changes and by the Na-ion concentration. These departures are entirely reproducible, however, and correction curves have been furnished for use with two commercial types of glass electrode. The theory of these errors is briefly reviewed. AUTHORS.

3727. Normal Potential of the Mercury-Mercurous Iodide Electrode. R. G. Bates and W. C. Vosburgh. *Am. Chem. Soc., J.* 59. *pp.* 1188–1190, *July*, 1937.—Measurements are made at 25° of the e.m.f. of the cell $\mathrm{Hg/Hg_2I_2}$, HI/HI/H_2 (Pt), in which the HI is furnished either by a solution of KI and HCl or by a solution of KI, HAc and NaAc. The value of E^0_{25} was found to be 0·0405 V. From this value and data from the literature, normal potentials for the lead amalgam-lead iodide and iodine electrodes are calculated. AUTHORS.

3728. Standard State of Copper and the Copper-Cupric Electrode. L. M. Adams and D. J. Brown. *Am. Chem. Soc., J.* 59. *pp.* 1387–1388, *July*, 1937.—The factors involved in the preparation of the standard state of Cu are studied. Crystals of Cu that are grown slowly at 25° should be considered as the standard state and the value of the normal electrode potential is 0·3472 V. AUTHORS.

3729. Anodic Polarisation of Tungsten. J. P. E. Duclaux. *Comptes Rendus*, 204. *pp.* 1633–1635, *May* 31, 1937.—When H_2SO_4 (sp. gr. 1·842) is electrolysed between electrodes of W a layer of high resistance is formed at the anode. Reproducible results are obtained if the states of electrodes and electrolyte are kept strictly constant. It is then shown that development of resistance is independent of strength of current, and depends solely on the nature of the surface. C. A. S.

***3730. Polarograph in Iron Control Laboratories. G. Thanheiser and G. Maassen.** *Naturwiss.* 25. *pp.* 426–429, *June* 25, 1937.—A simple polarograph is described. Such a piece of apparatus permits, *e.g.*, Cu and Ni, or Co and Ni, to be quickly and simultaneously determined in steels. J. K.

See also Abstracts 3328, 3333, 3335, 3672, 3676, 3685, 3739.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

3731. Coulomb Force Between Electron and Proton. U. Kakinuma. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 503–509, *May*, 1937. *In English.*—The author continues the development of his theory of the electron [see Abstract 5275 (1936)] based on the notion of a metric space which represents the interior of the electron. By the introduction of the idea of negative length, he attempts to account for the Coulomb force between the electron and the proton, regarding these as pulsating spheres in an incompressible fluid. G. C. McV.

***3732. Electron Diffraction Apparatus and its Use for the Estimation of the Inner Potentials of Ionic Lattices. P. A. Thiessen and T. Schoon.** *Zeits. f. phys. Chem.* 36. *Abt. B.* 3. *pp.* 195–215, 1937.—Full constructional details of an electron diffraction camera employing a hot kathode with focusing anode are given. The 40-kV electron beam is deflected through 90° by means of a magnetic field and subsequently focused, whilst by means of a magnetic prism it can be made to impinge upon the specimen under examination or on a standard gold specimen, to give a reference pattern. Using two regions at successively lower pressures the photographic plate can be changed without admitting air to the diffraction section. The apparatus is used for an examination of single crystals of KCl and it is shown that for second-order reflections from the cleavage face the apparent inner potential is 3·76 V, third order 7·44 V, rising to a steady value of about 9·10 V for the fourth and higher orders. This is explained in terms of the Lennard-Jones effect according to which a decrease of the lattice dimensions occurs in the planes bounding an ionic crystal. [See following Abstract.] A. G. Q.

3733. Diffraction of Electrons at Natural Faces of Organic Single Crystals. P. A. Thiessen and T. Schoon. *Zeits. f. phys. Chem.* 36. *Abt. B.* 3. *pp.* 216–231, 1937.—Single crystals of organic substances are examined by the grazing incidence method of electron diffraction [see preceding Abstract] and also by X-rays. It is claimed that by using the two methods in co-operation structural analysis can be carried out more quickly and with increased certainty. Thus, X-ray evidence showed that the bulk of a stearic acid crystal consisted of the unstable β-form of lattice dimensions $a = 5{\cdot}54$, $b = 7{\cdot}381$ Å. and $\beta = 63° 38'$, whereas for the surface layers of the same crystal electron diffraction gave $a = 9{\cdot}36$, $b = 4{\cdot}95$, $c' = 2{\cdot}43$ Å and $\beta = 51° 12'$. Evidence is given to show that there is no transformation of the surface due to localised heating by the electron beam, and by analogy with other work it is deduced that the surface layers of a crystal of β-stearic acid consist of the stable α-form. The lattice parameters of the paraffins $C_{30}H_{62}$ and $C_{31}H_{64}$ are given as $a = 4.95$, $b = 7{\cdot}54$, $c' = 2{\cdot}52$ Å, $\beta = 56{\cdot}5°$; and $a = 4.95$, $b = 7{\cdot}42$, $c' = 2{\cdot}52$ Å, $\beta = 90°$, respectively. A method is described whereby the molecular grouping in the crystal surface may be determined from electron diffraction results, and the inner potentials are given for the substances examined. A. G. Q.

3734. Pair Production by Collision of Charged Particles. G. Racah. *N. Cimento*, 14. *pp.* 93–113, *March*, 1937.—The efficiency of production of couples by the collision of charged particles is calculated by the perturbation method, considering the interaction between an electron in a state of negative energy and a particle in motion with the high velocity in the neighbourhood of a fixed nucleus. C. J. B. C.

3735. Disintegration of High Energy Protons. G. Nordheim, L. W. Nordheim, J. R. Oppenheimer and R. Serber. *Phys. Rev.* 51. *pp.* 1037–1045, *June* 15, 1937.—The coupling between light and heavy particles assumed in the Fermi theory of β-decay makes it possible for high energy protons in passing through matter to transfer a considerable fraction of their energy to electrons and neutrinos. If it be supposed that this coupling is a maximum for relative energies of the light and heavy particles of the order hc/R, with R the range of nuclear forces, and is small for much higher relative energies, the most important process which occurs, for sufficiently energetic protons, can be pictured as a sort of

V. 19

photodisintegration of the proton by the contracted Coulomb field of a passing nucleus, the proton changing into a neutron and emitting a positron and a neutrino. With a coupling of the type described, and of the magnitude required by the proton-neutron forces, processes involving more than one pair of light particles will be relatively rare. The cross-section for the disintegration of a proton of energy E is found to be of the order $2\pi(h/Mc)RZ^2\alpha^2 \ln^2 (E/Mc^2)$, and is very small, even for heavy nuclei. The mean energy given to the positron per disintegration is of the order $2(hc/R)\ (E/Mc^2)/\ln (E/Mc^2)$. The positrons emitted in these disintegrations can account in order of magnitude for the incidence of showers observed under thick absorbers. AUTHORS.

3736. Production of Electron-Optical Pictures with Photoelectrons. H. Gross and G. Seitz. *Zeits. f. Physik*, 105. 11–12. *pp.* 734–737, 1937.—The crystalline structure of metals may be obtained by means of electron-optical pictures formed by photoelectrons emitted by the metal. A method is described for revealing the crystal structure of metals at relatively low temperatures. The Ba vapour method is used for activating the metal surface. The advantage of this method lies in the fact that the structure may be examined at any temperature between room-temperature and the melting point of the metal. Examples are given of the structure of Ni and Ag surfaces at various temperatures.

H. J. H. S.

3737. Equalisation of Contrast in Oscillograms with Fluctuating Writing Speeds. H. E. Hollmann. *Zeits. f. Instrumentenk.* 57. *pp.* 202–207, *May*, 1937.—An arrangement is described by which the intensity of the oscillograph ray or the spot of the fluorescent screen may be modulated in such a way that the intensity is proportional to the writing speed. In this way large fluctuations in writing speed, which normally lead to great contrast on the oscillogram give the same intensity on the record. In illustration an electrocardiogram is shown before and after equalisation of the intensity of the recording beam. H. J. H. S.

See also Abstracts 3317, 3324, 3325, 3326, 3327, 3414, 3510, 3511, 3529, 3647, 3699, 3752.

ELECTROSTATICS.

3738. Potential of a Screen of Circular Wires between Two Conducting Planes. R. C. Knight and B. W. McMullen. *Phil. Mag.* 24. *pp.* 35–47, *July*, 1937.—In continuation of work by Howland and McMullen [see Abstract 4534 (1936)] and by Knight [*Proc. Lond. Math. Soc.*, 2. *pp.* 272–281, 1937] the authors discuss the potential problem of an infinite row of circular wires placed between two infinite planes subject to boundary conditions that the potentials of the wires and of the planes are constant and, in general, different. The harmonic functions occurring in the solution are given in the general form when the circles representing the wires in two dimensions are not symmetrically placed between the wires; the numerical solution is restricted to the symmetrical case when the line of centres of the wire is midway between the planes. The form of the equipotentials is given. The method of analysis consists in constructing harmonic functions having singularities at the centres of the circles and producing zero potential on the parallel straight lines representing the planes. These functions are then multiplied by constants and added to the function producing the required potential on the straight lines. J. S. G. T.

***3739. Electrolytic Condensers. W. C. van Geel and A. Claassen.** *Philips Techn. Rev.* 2. *pp.* 65–71, *March*, 1937.—This article discusses the characteristics of electrolytic condensers and outlines the principles of their operation. Different types of electrolytic condenser for a variety of duties are described. AUTHORS.

***3740. Theory of Toroidal Shape H.V. Collecting Electrodes. Marguerite Moreau-Hanot.** *Comptes Rendus*, 204. *pp.* 1549–1552, *May* 24, 1937.—In a previous paper [see Abstract 2875 (1936)] it had been shown qualitatively that surfaces derived from a torus were more suitable for h.v. collectors or capacities than the more usually adopted spherical shapes. This article gives a detailed theoretical study and concludes with some specific examples. F. S. B.

See also Abstracts 3306, 3387, 3708, 3787.

MAGNETISM AND ELECTROMAGNETISM.

3741. Lagrangian Form of Electromagnetic Force. G. Racah. *Accad. Lincei, Atti*, 25. *pp.* 223–226, *March* 7, 1937.—It is well known that the laws of motion of a charged particle in an electromagnetic field can be expressed in Lagrangian form. The present paper proves the converse result, that Lorentz's law of force $F = e\ (E + v \times B/c)$ is the only law of force which depends solely on the position and velocity of the point of application and which is of Lagrangian form. Moreover, the relations div $B = 0$ and curl $E + \mathrm{B}/c = 0$ must be satisfied by the two vectors E and B in the above law. A. J. McC.

3742. Analysis of Processes Involved in Magnetisation. K. H. R. Weber. *Zeits. f. Physik*, 105. 11–12. *pp.* 676–697, 1937.—In a previous paper [see Abstract 1359 (1936)] it is shown that the Weiss theory is capable of explaining the observed phenomena of magnetisation, with certain exceptions; these are now examined. By a simple extension of the Weiss theory it is found possible to account for the exceptions and for a number of phenomena closely related to magnetisation.

H. J. H. S.

3743. Magnetic Permeability of Ferromagnetic Bodies in H.F. Fields. J. Zimowski. *Acta Physica Polonica*, 6. 1. *pp.* 6–11, 1937. *In French.*—The magnetic permeability of a number of Fe compounds (magnetite, haematite, pyrites, etc.) is studied in fields with frequencies ranging from 5×10^6 to 2×10^7 (15–60 m.). For Fe and magnetite the permeability decreases as the frequency increases but for the other compounds no change is observed. H. J. H. S.

3744. Magnetic Stability. R. Goldschmidt. *Helv. Phys. Acta*, 10. 2. *pp.* 225–236, 1937. *In German.*—The problem of curing instabilities in telephonic circuits which contain ferromagnetic materials, usually of high permeability in weak fields, is an important one and it is considered from the physical standpoint. A summary is given of the present state of knowledge of the physical properties of the types of material used in telephonic circuits (soft Fe, soft and hard Ni-Fe alloys) and the properties of chief importance are discussed. Stability curves are described, which show the special suitability of the hard Ni-Fe alloys for use in weak fields. The mechanism of magnetisation is discussed with particular reference to the phases in the process. The laws of Gans and Weiss are discussed and illustrated by curves showing reversible permeability; the hysteresis loss of soft and hard Ni-Fe alloys is mentioned and its relation with the mechanism of magnetisation is pointed out. H. J. H. S.

V.
19

3745. External Field of a Permanent Magnet Ellipsoid. H. Neumann and K. Warmuth. *E.N.T.* 14. *pp.* 168–180, *May,* 1937.—A previous paper [see Abstract 5690 (1936)] is extended to the treatment of the external field of a permanent magnet ellipsoid for the 1st Gaussian principal position; the field is calculated and the results shown graphically. For the intermediate Gaussian position (between the 1st and 2nd Gaussian position $0 < \alpha < 90°$) the external field is calculated for the cases when the dimension ratio (D.R.) is 2·5, 5, 10, 25 and 50, and the results are given graphically. The relations found by Gauss for the external field in the 1st and 2nd principal positions are verified; when $\alpha = 45°$ and the distance from the centre of the ellipsoid is large, the H_x component of the external field vanishes and the resultant field is equal to the H_y component of the external field. The components and the resultant of the surface field of an ellipsoid are calculated and expressed in a graphical form. A method is described for obtaining curves of equal external field for any given permanent magnet ellipsoid. An extension of the treatment to bar magnets leads to good agreement when the ellipsoid approximates to a bar, but when it has a small D.R. the calculated values are higher than those obtained by experiment. H. J. H. S.

3746. Recoil Cycles of Magnet Steels. H. Lacoste-Tayan. *Comptes Rendus,* 204. *pp.* 1556–1558, *May* 24, 1937.—The magnetic condition of a permanent magnet is determined at any instant by the conditions prevailing in the exterior part of the magnetic circuit of which it forms a part. It may be represented by a point located in the quadrant of negative H and positive $4\pi I$ and in the interior of the curve obtained in passing from positive to negative saturation. In the case of periodic excitement (such as in magnetos) a closed loop is obtained in which the limits are practically H (residual) and H = 0. A brief description of the properties of these closed loops is given, with illustrations.

H. J. H. S.

3747. Magnetic Susceptibility of Copper Amalgam. H. S. Venkataramiah. *Indian Acad. Sci., Proc.* 5*A*. *pp.* 532–534, *June,* 1937.—In general the susceptibility of a liquid or solid metal on admixture with small quantities of foreign metals, deviates from the value deduced according to the mixture law in the direction of greater diamagnetism. It has also been found that the electrical conductivity of the metal is at the same time brought down by such admixtures. These changes may be traced to a common cause, the decrease in the effective number of free electrons. The case of Hg is exceptional as revealed in the present work and those of other workers. The diamagnetism of the amalgams including that of Cu is less than the value obtained from the additivity relation. Hence on amalgamation the effective number of free electrons must increase. That such an increase occurs is supported by the fact that the electrical conductivitiy of Hg is increased by the presence of foreign metals in it. AUTHOR.

3748. Magnetic Study of Complexes. N. Perakis and L. Capatos. *Comptes Rendus,* 204. *pp.* 1799–1802, *June* 14, 1937.—The mixed tetrapyridine persulphates $[Ag_xCd_{(1-x)}4C_5H_5N]S_2O_8$ $(x = 0 - 1)$ were similarly examined for temperatures between 83° and 294° Abs. The Curie point, Curie constant, and magnetic moment all decrease, but at a gradually decreasing rate and somewhat irregularly, as x increases; the two last only change between 0·479 and 0·420, and 0·7 and 0·11 respectively, as x varies between 0·24 and 1·0. The ion Ag^{II} has in very dilute solution in

Cd a large and constant paramagnetism, but in more concentrated solution this is variable. [See also Abstract 4375 (1936).] C. A. S.

3749. Magnetism and Polymerisation. Part II. J. Farquharson. *Faraday Soc., Trans.* 33. *pp.* 824–827, *July,* 1937.—A magnetic study of the polyoxymethylene diacetates gives a value for the $-CH_2O-$ group in combination which is smaller than would be expected from Pascal's additivity rule. By means of this value it is possible to estimate the number of $-CH_2O-$ groups in α and β polyoxymethylenes. [For Part I see Abstract 879 (1936).] AUTHOR.

3750. Diamagnetism and Paramagnetism in Metallic Mixed Crystals. Part IV. E. Vogt. *Ann. d. Physik.* 29. 3–4, *pp.* 358–368, *June,* 1937.—An account of methods of evaluation in measurements of paramagnetism of dissolved transition metals. The paramagnetism of weak solutions of mixed crystals of transition metals and Cu, Ag and Au, in cases where it is dependent on the temperature, can usually be represented by the Curie-Weiss law: $\chi = \chi_0 + C/(T - \theta)$. If χ_0 is taken as the diamagnetism of the noble metal, the measurements of the behaviour of the dissolved metal give two empirical constants, C and θ. The above equation holds in some cases only in narrow temperature ranges, and C and θ change with the temperature. In some cases the change takes place at a definite temperature, in others the graph of $1/\chi$ with T is curved. The equation is therefore only a first approximation. Certain results for Mn alloys found by using the above law may also be reckoned by using the form: $\chi = C/(T - \theta)$. Some circumstances appear to favour the use of the latter law. Formulæ are worked out by which, if the relation of χ and T is determined by one method, the constants of the other method can be calculated. [See also Abstract 1342 (1934).] G. E. A.

3751. Diamagnetism of Organic Sulphur Compounds. A. Clow and J. M. C. Thompson. *Faraday Soc., Trans.* 33. *pp.* 894–904, *July,* 1937.—The method of calculating diamagnetic susceptibilities given by Gray and Cruickshank [see Abstract 5232 (1935)] has been extended to sulphur compounds, the necessary atomic susceptibility constants and bond depressions for all the usual bonds, Δ_{H-S}, Δ_{C-S}, $\Delta_{C=S}$, etc., being calculated. The susceptibilities of some twenty representative thio-compounds are given, and problems bearing on the structure of the following compounds are discussed: thioacetic acid, thio-amides, co-ordination in hydrogen sulphide, disulphides, rhombic sulphur, thiophene, resonance in carbonyl sulphide and carbon disulphide, etc. A modification which enables the Curie-Chéneveau magnetic balance to be used for the measurement of the diamagnetic susceptibilities of liquefied gases is described. AUTHORS.

3752. Diamagnetism of Electron Gas. A. Papapetrov. *Zeits. f. Physik,* 106. 1–2. *pp.* 9–16, 1937.—The results of Landau [see Abstract 989 (1931)] for the diamagnetism of electron gas are only applicable for field strengths greater than a limiting value. Below this value greater diamagnetism is to be expected. W. R. A.

3753. Electromagnetic Field of the Electron in Motion. R. Reulos. *Ann. de Physique,* 7. *pp.* 700–789, *May–June,* 1937.—Deficiencies of the method of retarded potentials for the calculation of the electromagnetic field of charges in motion are briefly discussed, and the author proposes a method of integration of Maxwell's equations which gives, as it were, a bird's-eye view of the whole field at a given instant, the motion of the charges in the field being known. In the theory developed, electric density is not considered as of fundamental significance; it is therefore not necessary to attribute a structure to the electron as in the theory of Lorentz. The theory developed is based upon the conception of a series of vortex terms, each term being the vorticity of the succeeding term. The electrostatic field of a particle is the first term of the series. The theory is applied to the cases of rectilinear and curvilinear motion of a charge and to the discussion of induction. J. S. G. T.

3754. Matrix Representation of Maxwell's Equations. G. Petiau. *Comptes Rendus*, 204. *pp.* 1710–1713, *June* 7, 1937.—The matrix form of Maxwell's classical equations of the electromagnetic field, which is suggested by the work of Darwin and Temple, is compared with the corresponding set of equations for the photon proposed by de Broglie. The latter are shown to be a symmetric set of equations somewhat more general than those of Maxwell. G. C. McV.

3755. Eddy Currents in Laminated Cores of Rectangular Section. M. Reed. *I.E.E., J.* 80. *pp.* 567–578, *May*, 1937.—It is shown that a complete verification of the well-known theory of eddy-current shielding in plane sheets can be obtained by measuring the variation of the impedence which frequency of a coil wound on a laminated core consisting of non-magnetic material. The verification of the theory is straightforward when the screening effect is small, because laminations thin enough to simulate the conditions of the plane sheet can be used, whereas much thicker laminations are necessary when the screening effect is large, and the simple theory must be extended to include the ratio of lamination thickness to lamination width. This extension is derived from an analysis of the eddy currents in an elliptical core, which, as the measurements show, applies to a rectangular core when the screen effect is large. When the screening effect is small, however, the results of the analysis of the elliptical core no longer apply to the rectangular one, and the difficulties of obtaining a mathematical solution in this case are indicated. With magnetic laminations the simple theory no longer holds in practice, and Peterson and Wrathall [see Abstract 1879 (1936)] have shown that it is necessary to modify this theory to take into account the presence of a surface layer. The modifications are examined in an Appendix, and the results obtained indicate that they apply when the screening effect is negligible, but not when it is large. Nevertheless, the equations obtained by Peterson and Wrathall are shown to provide a means of evaluating the thickness of the surface layer. AUTHOR.

3756. Eddy-Current Heating of Composite Cylindrical Systems. D. A. Wright. *Phil. Mag.* 24. *pp.* 1–26, *July*, 1937.—Expressions are deduced for the penetration of field through the wall of a cylindrical tube carrying eddy currents and containing an inner cylindrical charge, and for the watts developed in the outer tube under these conditions. Knowing the watts developed in the inner charge per unit field at its surface, it is then possible to deduce the watts in the inner charge per unit field outside the outer tube. Comparison of the watts in the two cylinders then indicates the practical possibility of eddy current heating the inner cylinder, while a study of the variations of the two quantities with frequency enables the optimum conditions to be determined. Under certain conditions it is sufficient for practical purposes to use for the watts developed in the outer tube and for penetration through it formulae as given by Oatley [see Abstract 4887 (1936)] for the empty tube. It is shown in what types of system this is sufficient, and in what types it is important to ultise the present theory. Two examples of the latter type of system are examined in some detail. A brief account is given of practical work which confirms the conclusions regarding the behaviour of one system of this type. AUTHOR.

3757. Influence of Hydrostatic Pressure on Saturation Magnetisation. H. Ebert and A. Kussmann. *Phys. Zeits.* 38. *pp.* 437–445, *June* 15, 1937.—Measurements on Fe, Ni and a wide range of alloys are described showing in most cases a very small effect of pressure on saturation magnetisation (negative coefficients between 10^{-7} and 10^{-6} per kg./cm.^{2}). In certain alloys, however, *e.g.*, 30% Ni-Fe, 60% Pt-Fe and 55% Co, 9% Cr, 36% Fe, large negative coefficients (up to $6 \cdot 5 \times 10^{-5}$ per kg./cm^2) are found. This increased pressure-effect appears to depend on the alloy composition being near an α-γ transformation associated with large temperature-hysteresis. Theoretical explanations are discussed and the effect is attributed to variation in the interactions of the atoms. This view is consistent with Dehlinger's explanation of the properties of invar [see Abstract 4491 (1936)]. C. E. W.

***3758. Rate of Growth and Decay of Currents in Electric Circuits. G. E. F. Fertel and R. W. B. Stephens.** *Am. Phys. Teacher*, 5. *pp.* 122–126, *June*, 1937.—A specially designed copper-contacting system in conjunction with a phonograph motor and turn-table is used to measure an electric current 1/360 sec. and upwards after it is set up in a circuit. Various student experiments are described for circuits containing capacitance, resistance and inductance. AUTHORS.

***3759. Rankine Magnetic Balance and Magnetic Susceptibility of H_2O, HDO and D_2O. H. P. Iskenderian.** *Phys. Rev.* 51. *pp.* 1092–1096, *June* 15, 1937.—Details are given of the construction of a Rankine magnetic balance which realises the full theoretical sensitivity of this type of instrument. The volume magnetic susceptibilities of stated mixtures of light and heavy water relative to that of ordinary water are reported, and from these data the relative mass susceptibilities of HDO and D_2O are deduced. The mass susceptibility of H_2O is assumed to be $-0 \cdot 7200 \times 10^{-6}$, in terms of which that of HDO is $-0 \cdot 6807 \times 10^{-6}$ and of D_2O is $-0 \cdot 6466 \times 10^{-6}$. AUTHOR.

***3760. Astatic Magnetometer for Measuring Susceptibility. E. A. Johnson and W. F. Steiner.** *Rev. Sci. Instruments*, 8. *pp.* 236–238, *July*, 1937.—A rugged type of astatic magnetometer has been designed and built for use in the shop and laboratory to measure the susceptibility of materials. The sensitivity may be adjusted from 2×10^{-8} to 1×10^{-5} electromagnetic c.g.s. unit per scale division, allowing the measurement of volume susceptibility of practically any material. AUTHORS.

See also Abstracts 3418, 3680.

MEDICAL RADIOLOGY AND ELECTROLOGY.

3761. Nerve Excitation by Alternating Currents. N. N. Malov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 14. 7. *pp.* 437–440, 1937. *In German.*—An analysis of the ion theories of nerve excitation developed by Nernst and Hill shows that they do not explain the experimental results over the whole available frequency range. The galvanic polarisation theory of Warburg and Kruger is applied to the problem and it is shown that the outstanding difficulties can be overcome. J. E. R.

3762. Electric Shock and Its Effect on the Human Body. S. W. Fisher and G. M. Harvey. *M.E.E.* 17. *pp.* 371–375, *May*; *and Disc.*, *pp.* 412–415, *June*, 1937.—A summary of published information, with an analysis. The effects of electric shock on the body include (*a*) asphyxia due to muscular contraction, (*b*) fibrillation of the heart muscle, (*c*) paralysis of the respiratory centre, (*d*) simultaneous failure of the heart and respiration, (*e*) injuries by burning, etc. For a.c. of 50∼ the threshold of perception is 1 mA; for loss of control to commence, 15 mA; the threshold of danger to life, 25 mA, and 100 mA is given as the threshold of fibrillation, or irregularity and weakness of pulse. The most dangerous current path is one that includes the heart. Fibrillation is usually produced by voltages from 200 to 500, applied for a time exceeding 0·1 sec. Artificial respiration is often of no avail, but it should be used always as it is the only possible method in the absence of medical resources. Tables of data on fatal and non-fatal accidents are given, with comments. The varying resistance of the body is discussed, and it is stated that it is about 600 ohms if contact is made beneath the skin, but through the skin it may reach 100,000 ohms. A curve shows the shock voltage for different cases, derived from shock current and body resistance. [See also Abstract 3355 (1936).] E. H. W. B.

3763. Field Characteristics in the Region of Very Short Waves. Spontaneous Rotating Fields. W. Krasny-Ergen. *Hochfrequenztechn. u. Elektroakustik*, 49. *pp.* 195–199, *June*, 1937.—A discussion is given of the characteristics of the field produced when a homogeneous, infinitely long cylinder is introduced into a homogeneous medium in which there initially existed a uniform alternating field normal to the axis of the cylinder. It is shown that in a certain frequency region the behaviour of the field in the space external to the cylinder may be quite different in different phases. In this frequency region, moreover, spontaneous rotating fields may arise in the space external to the cylinder. The occurrence of these rotating fields is probably connected with certain non-thermal effects of alternating electric fields on colloids. The frequency region in question lies in the short and ultra-short wave region used in biological research. [See also Abstract 5696 (1936).] A. W.

3764. E.H.F. Loading of Double Conductors. N. N. Malov. *Phys. Zeits. d. Sowjetunion*, 11. 5. *pp.* 539–544, 1937. *In German.*—In laboratory investigations of electro-medical apparatus it is sometimes necessary to determine the circuit loading due to the introduction of some object between the plates of a condenser forming part of an e.h.f. circuit. In practice there is always an air-gap between the condenser plates and the surface of the object and in consequence the increase of resistance due to the object is not large. Drude's method is not suitable for measuring this resistance and measurements were therefore made by the method developed by Roosenstein and Tatarinov. The condenser into which the object is introduced is at one end of a pair of conductors, the other end being coupled to a h.f. generator. The equivalent complex resistance can be determined from the voltage distribution along the conductors. Measurements were made with wave-lengths of the order of 3–4 m. and the results obtained with different types of circuit loading (ohmic, inductive and capacitive) showed good agreement with calculated values. A. W.

3765. Evaluation of Bone Density by the Use of Ivory Wedges. I. Stein. *Am. J. of Roentgenology and Radium Therapy*, 37. *pp.* 678–682, *May*, 1937.—In the evaluation of the density of bone as demonstrated radiographically, various technical factors, developments, etc., give rise to errors. Comparison of density of radiographs has been made in the past by means of aluminium of different thicknesses. The author has utilised, in preference to aluminium, stepped thicknesses of ivory, which more closely approximates to actual bone. The method of comparison of films of bone is described with illustrated graphs. The apparatus is simple and inexpensive. B. J. L.

3766. Viewing Lantern. W. V. Mayneord. *Brit. J. of Radiology,* 10. *pp.* 527–528, *July,* 1937.—The lantern described is of the normal type used for the examination of radiographic negatives, the inner walls, however, being lined with plane mirrors. The ring of images produced by the mirrors, together with the usual central lamp form an arrangement of sources which approximate to that required theoretically to give a uniform distribution of radiation over the viewing screen. The curves given show variations in light intensity over the screen of about 2%, as against 100% in the standard type of lantern. J. E. R.

3767. Ultra-Violet Energy in Daylight. M. Luckiesh, A. H. Taylor and G. P. Kerr. *Frank. Inst., J.* 223. *pp.* 699–714, *June,* 1937.—The authors have obtained, for the past two years, continuous records of u.v. radiation in daylight, including both sunlight and skylight, using a Cd alloy photo-cell with maximum sensitivity at 280 mμ. A description of the apparatus is given and this is followed by an account of the results obtained. The values are expressed in terms of erythemal effect, the unit employed being the E-viton/cm.^{2} where one E-viton is 10 μW of energy weighted according to the erythemal response curve. Typical curves are given for the u.v. energy (expressed in E-vitons/cm.^{2}) on a horizontal plane on clear days in April, June and September at Cleveland, N.Y. The authors find that for about eight months in the year a clear sky contributes more than half of the erythemal u.v. energy incident on a horizontal plane. The separate contributions of the sun and sky are shown in typical graphs. Some measurements were also made of the u.v. energy received through an open window facing in various directions. J. W. T. W.

3768. Method for Decreasing the Ionisation in the Skin Applicable to H.V. X-Ray Therapy. G. Failla, G. Twombly and L. Marinelli. *Radiology,* 28. *pp.* 693–703, *June,* 1937.—Therapeutic effects of X-rays and radium are due to ionisation which destroys the cells of tumours. In deep therapy, damage occurs in this respect to normal cells of superficial tissues. The authors have carried out experimental investigations to remove the secondary electrons due to ionisation by use of a magnetic field, or alternatively, canalisation of the radiation beam, the latter method being applicable since the secondary electrons do not travel in straight lines. Removal of these secondary electrons reduces the injurious effects at superficial layers of tissue, but sufficient secondary electrons can be produced at a depth to give the desired therapeutic effects at a deeply situated tumour. In consequence injury to superficial tissues such as the skin is minimised. Experiment shows that a layer of tissue of depth 4 mm. is so protected by removal of secondary electrons. Sufficient radium has not been available to carry out experiments but it is suggested that the method is of use up to X-ray voltages of 10^6 V. B. J. L.

3769. Artificial Radioactivity in Radiotherapeutics. A. Lafay and B. Lafay. *Comptes Rendus,* 204. *pp.* 1593–1594, *May* 24, 1937.—Neutrons obtained from the photo-nuclear disintegration of Be by γ-rays from 2–3 mg. of Ra are used to produce the radioactive isotopes by bombardment of As and I. These elements, in the form of solutions of their salts contained in ampoules ready for therapeutic injection, have been irradiated in a cavity in paraffin wax to make use of the enhanced effect of slowing the neutrons from the source, consisting of a sealed Ra container surrounded by powdered Be. Intravenous injections of radioactive NaI have been given in the treatment of rheumatism, with results, it is claimed, at least as good as those obtained with mesothorium, ThX and Rn without the alteration in blood picture produced by the latter. On account of the alleged affinity of I to cancerous tissue, which these experiments claim to confirm, radio-iodine can be used to bring a source of β-rays in direct contact with malignant cells. It is considered that this is a unique method for irradiating deeper tissues without the production of surface burns and that the view of certain radiotherapists is confirmed, that β-rays are more efficacious than X- or γ-rays in their curative effect. Finally it is suggested that the accumulation of radio-iodine in cancerous tissues renders these temporarily radioactive and makes their existence detectable by electro-diagnostic methods. T. A. C.

***3770. Distribution of γ-Rays round a Ring Source. J. E. Roberts and Joan M. Honeyburne.** *Brit. J. of Radiology*, 10. *pp.* 515–525, *July*, 1937.—A dosemeter is described suitable for use over a wide range of radiation qualities and dosage rates. Measurements with point and ring sources indicate that owing to compensation of absorption and scatter the distribution of radiation in a scattering medium is very similar to that in air; when the radium is on the surface of the medium the compensation is incomplete, and there is a small apparent absorption. Isodose curves are given for a simple ring source in air and when placed on the surface of a scattering mass, and it is shown that in air the measured distributions agree well with the calculated values. AUTHORS.

3771. International Recommendations for Radiological Units. *Brit. J. of Radiology*, 10. *pp.* 438–444, *June*, 1937.—Draft proposals are put forward by the British X-Ray and Radium Units Committee, for revising the International Recommendations for Radiological Units. It is submitted that satisfactory evidence now exists for the adoption of a single unit, the röntgen, as the unit of quantity of X-rays of all wave-lengths and of γ-rays. For this purpose it is necessary to adopt a somewhat more generalised definition of the röntgen, and two alternative definitions are suggested. Recent γ-ray measurements are summarised and it is submitted that for present medical purposes, the quantity of γ-radiation received in 1 hr., at a distance of 1 cm. from a point source of 1 mg. of Ra element surrounded by 0·5 mm. Pt. may be regarded as approximately equivalent to 8 röntgens. Minor modifications are suggested in the specification of the conditions of X-ray and γ-ray treatments. J. E. R.

See also Abstracts 3492, 3639, 3737.

OSCILLATIONS AND WAVES.

***3772. Radio-Oscillator with Air-Coil Induction Coil. C. Williamson.** *Am. Phys. Teacher*, 5. *pp.* 135–137, *June*, 1937.—The device consists of an a.f. oscillator with an air-core inductance of 10 H of Maxwell cross-section. It is tuned over the range 64–2048 ~ with the aid of a 3-decade condenser and a variable condenser. The low range may be extended to 45 ~. No tap-changing is necessary. Variations of

30 % in plate-supply voltage or 10 % in filament voltage do not change the frequency more than 0·1 %. The no-load output of the direct-coupled amplifier stage is 25 V (r.m.s.) at all frequencies. The average total harmonic content is less than 5 %. AUTHOR.

3773. Valve Amplification in the Study of Single Elementary Particles. Part II. M. Mandò. *N. Cimento,* 14. *pp.* 119–139, *March,* 1937.—Continuing previous work [see Abstract 2836 (1937)], the optimum conditions for valve amplification in the study of single elementary particles are examined mathematically. The basically important factor is considered to be rapidity of recovery and a circuit is evolved in which priority is given to this factor at the expense of sensitivity. F. C. C.

3774. Diffraction of Electromagnetic Waves from an Electrical Point Source round a Finitely Conducting Sphere, with Applications to Radiotelegraphy and the Theory of the Rainbow. Part I. B. van der Pol and H. Bremmer. *Phil. Mag.* 24. *pp.* 141–176, *July,* 1937.—The problem of diffraction of electromagnetic waves radiating from a point source outside an absorbing sphere is treated by several methods. In the present paper an exposition of the method of Watson is given. This method consists in a transformation of the infinite series of spherical harmonics for the Hertzian vector into another series, which is much more rapidly converging for wave-lengths small compared with the dimensions of the sphere. Extensive numerical results are given for the case that the point source is a transmitter of radio waves, which may be situated on the surface of the, in general, finitely conducting sphere as well as at a small height above it. The former method is compared with that of development in characteristic functions, which is analogous to methods used in string problems and wave mechanics. AUTHORS.

3775. British Radio Observations during the Second International Polar Year 1932-1933. E. V. Appleton, R. Naismith and L. J. Ingram. *Roy. Soc., Phil. Trans.* 236*A*. *pp.* 191–259, *April* 10, 1937.—The paper describes the results of observations made by British workers chiefly at Tromsö in N. Norway and Slough in S.E. England. The programme of observations followed was that of the U.R.S.I. with a special British programme in addition. The main effort was devoted to continuous determinations of the height of the reflecting layer for frequencies of 2 and 4 Mc./sec. along with determinations of maximum ionic density of the various ionospheric regions by the critical frequency method. Abnormal radio effects were found to be associated with periods of magnetic activity, especially at Tromsö, and a detailed account is given of a magnetic storm of moderate severity in which it was possible to follow the sequence of ionosopheric events. F. S. B.

3776. Chromospheric Eruptions and Short-Wave Radio Fading. R. S. Richardson. *Roy. Astron. Soc. Canada, J.* 31. *pp.* 193–198, *May–June,* 1937.—It is believed that sudden fade-outs of h.f. radio transmission affecting the daylight side of the earth and lasting some 15 min. are connected with bright eruptions in the solar chromosphere. A periodicity in the radio observations of about 54 days, twice the synodic time of solar rotation in latitude 16°, is established. The paper records the results of the Mt. Wilson programme for observing the phenomenon. H and Ca$^+$ spectroheliograms, taken automatically every 4 min. on all clear days since May 1936, show 149 eruptions, 34 of which coincide closely with radio fade-outs. An effective eruption is always very bright and always precedes the corresponding fade-out, sometimes by 2 or 3 min., sometimes by 10 or more. Slight disturbances of the earth's magnetic field may also occur. The eruptions connected with radio fading are distributed practically as the others are in heliographic latitude, but, unlike spots producing magnetic storms, favour no particular heliographic longitude. This fact and the shortness of the time-interval suggest that the fading is caused by radiation emitted from the eruption. A. Hu.

3777. Radio Fade-Outs. L. V. Berkner and H. W. Wells. *Terr. Mag.* 42. *pp.* 183–194, *June*, 1937.—The radio fade-out effect reported by Dellinger and Jouaust can be studied from the echo-disappearance observed on the ionospheric traces during such disturbances. Twenty months of continuous data from Huancayo (Peru) and 5 months of data from Watheroo (Western Australia) are analysed. The data are presented in more quantitative form than heretofore available. The results are in general agreement with the reports of Dellinger except that no recurrence or quasi-recurrence tendency can be shown from the data available. It is concluded that the data support Dellinger's hypothesis of the origin of these effects in bright chromospheric eruptions and that the effect is an absorption of h.f. radio waves in the region between about 60 and 100 km. because of increase of ionisation. The higher ionospheric regions are apparently unaffected, indicating no appreciable absorption of the radiation causing the fade-out in these regions. AUTHORS.

3778. Return of Radio Waves from the Middle Atmosphere. Part I. R. A. W. Watt, A. F. Wilkins and E. G. Bowen. *Roy. Soc., Proc.* 161*A*. *pp.* 181–196, *July* 15, 1937.—Observations spread over a year from May, 1935 have established the existence of sustained stratified electrification, of such ionisation density and gradient as to return radio waves of frequency 6–12 Mc./sec. at vertical incidence, at a variety of levels in the troposphere and the stratosphere. Strata persisting without substantial change of level for at least several days have been identified at such heights as 8·5, 9·3, 10·3, 10·75, and 13·5 km. with reflection coefficients, of the order of 0·7, giving measurable echoes up to the tenth order, beyond which they are not readily distinguished from ionospheric echoes. Apparently independent stratification at 45–50 km., with a reflection coefficient of 0·3 for waves of 6 Mc./sec., and the D region at and above 60 km., are also recorded. Reflections from all these regions are obtained, with significant reflection coefficients, at and above the frequencies proposed for television services. The ionisation does not fall to very low values at night, and has no seasonal variation of large amplitude. Evidence is given of replenishment around the 20–30 km. levels by local thunderstorms. AUTHORS.

3779. Extension of Normal-Incidence Ionosphere Measurements to Oblique-Incidence Radio Transmission. N. Smith. *Bureau of Standards, J. of Research*, 19. *pp.* 89–94, *July*, 1937.—A simple, rapid graphical method is given for obtaining skip distances and limiting frequencies for radio waves, from normal-incidence measurements. The applications of the method are outlined. AUTHOR.

See also Abstracts 3467, 3498, 3704, 3705, 3784, 3785.

PHOTOELECTRICITY.

3780. Photoelectric Schottky Effect in Films of Sodium and Potassium on Tungsten. R. C. L. Bosworth. *Faraday Soc., Trans.* 33. *pp.* 590–596, *April*, 1937.—In a study of the surface diffusion coefficients of K it has been found that whereas dilute films formed by condensation have a low mobility, concentrated films and dilute films formed from them by evaporation have a high mobility. It is therefore suggested that this last type of film consists of veins rich in alkali forming a meshwork over the surface. The variation of the photoelectric emission under white light for the three types of film above has been studied—for the first two types of the film the variation is in accordance with the Schottky theory—for the last the variation is far greater and this points to the very inhomogeneous nature of this film. The variation of both thermionic and photoelectric emission from dilute films of Na has also been studied and the films give a Schottky coefficient $T(d\log I/d\sqrt{F})$ of from two to three times the normal value calculated from the image field of an electron escaping from the surface. AUTHOR.

3781. Photovoltaic Effect for a Highly Insulating Material. G. Nadjakoff. *Zeits. f. phys. Chem.* 36. *Abt. B.* 4. *pp.* 314–321, 1937.—A disc of sulphur is irradiated through a layer of water in contact with it and it is found that a p.d. occurs when the spectral composition of the light is altered by interposition of a filter. This new effect is distinct from a possible Becquerel effect at the sulphur-water interface and must be regarded as a volume effect of the sulphur. L. A. W.

3782. External and Internal Photoelectric Effect in Non-Conductors. G. Nadjakoff. *Zeits. f. phys. Chem.* 36. *Abt. B.* 4. *pp.* 309–313, 1937.—Experimental results are adduced to show that the classical method of observing the Hallwachs-Lenard effect can be improved by coating the auxiliary electrode with a thin layer of paraffin wax so as to eliminate its external photelectric effect. With this improvement it is possible to decide whether an " inverse " photoelectric effect exists, to estimate the influence of the possible photoelectric conductivity of non-conductors, and to determine the wave-length threshold and magnitude of the normal effect. L. A. W.

See also Abstracts 3402, 3492, 3517, 3546.

PIEZOELECTRICITY.

3783. Piezodielectric Effect and Electrostriction in Anisotropic or Isotropic Media. H. Osterberg and J. W. Cookson. *Phys. Rev.* 51. *pp.* 1096–1101, *June* 15, 1937.—A phenomenological theory of the piezodielectric effect in homogeneous isotropic or anisotropic solids is presented. It is shown that 36 piezodielectric moduli are required for a complete description of the effect. The character of electrostriction in solids is predicted by considering the piezodielectric effect together with the first and second laws of thermodynamics. Equations for the components of " electrostrictive strain " in isotropic solids and α-quartz are given, together with general expressions for " electrostrictive stress." The equations of motion of a perfectly elastic, piezoelectric and electrostrictive solid subjected to mechanical and electrical fields are stated. It is shown that every solid may exhibit electrostriction whereas relatively few solids are piezoelectric. E. R.

***3784. Quartz Crystal Frequency Substandards. S. C. Hight and G. W. Willard.** *I.R.E., Proc.* 25. *pp.* 549–563, *May*, 1937.—This paper presents a new type of stabilised quartz-controlled oscillator and a new type of low-temperature-coefficient piezoelectric quartz circuit element which, in their combination, are particulary suitable for portable substandards of frequency. The oscillator circuit is simple and may be easily stabilised by two reactance adjustments so that the frequency is unaffected by change of valves or by small changes in the circuit reactances, the plate voltage, and the ambient temperature. Measured stabilities are given for this circuit when constructed as a substandard of frequency, employing the new CT crystal, and generating 100 kc./sec. and its harmonics. A previously unused type of vibration in quartz plates cut at an angle to the crystalline axes provides l.f. circuit elements with a wide range of temperature coefficients. Two specified orientations, designated as CT and DT cuts, exhibit zero temperature coefficient at specific temperatures and are closely related to the recent, but now popular, AT and BT h.f. plates. The new plates are especially useful in precision applications, for by slight final adjustment their frequency may be either raised or lowered and their temperature coefficient made either more positive or more negative. AUTHORS.

3785. Multi-Wave Oscillations of Piezoelectric Quartz Plates. K. Balzer. *Zeits. f. techn. Physik*, 18. 6. *pp.* 169–170, 1937.—From about 100 dust figures obtained by harmonic excitation of square or circular quartz plates a selection of 31 characteristic examples is reproduced. The simpler types observed are in agreement with the theory of oscillations in quartz plates. Other types of more complex character show clear evidence of the combination of two oscillations of the first kind, while a third type are still more complex and cannot at present be accounted for satisfactorily. These will be dealt with more fully in a further investigation. A. W.

3786. Piezoelectric Effect in Crystalline Powders. J. Engl and I. P. Leventer. *Ann. d. Physik*, 29. 5. *pp.* 369–385, *July*, 1937.—A method for the investigation of piezoelectric substances in the form of powder is described which depends on the following principle: a crystalline benzene mixture is brought as dielectric into a measuring condenser constructed in the form of a calorimeter and the result measured with high frequency as function of the wave-length. The piezoelectric portion has resonance character. The most important part of the apparatus is the measuring condenser formed as h.f. calorimeter, which depends on the principle of using the vaporising liquid also as thermometric substance. As vaporising liquid one loss-free for h.f. must be chosen, and benzene was taken as it is easily obtainable sufficiently pure. As crystal material quartz, whose dielectric losses are small and whose piezoelectric characteristics are best known, was used. J. J. S.

See also Abstracts 3407, 3708.

THERMIONICS.

3787. Distribution of Voltage in Thermionic Valves. L. Rosenhead and S. D. Daymond. *Roy. Soc., Proc.* 161*A*. *pp.* 382–405, *Aug.* 3, 1937.—Maxwell's formula for the capacity of a triode composed of a row of rectilinear cylindrical conductors of small circular section between plane anodes and kathodes suggests an accuracy not justified by the analysis. A review of the investigation results in a formula which differs only slightly from the original one when the dimensions of the triode are those of the valves in current use. The method employed is a general one and can be applied to a wide range of cases. A number of these cases have been worked out and the coefficients of capacity are given.

3788. Ionisation of Potassium Atoms at Glowing Platinum and Tungsten Surfaces. H. Mayer. *Zeits. f. Physik,* 105. 11–12. *pp.* 725–733, 1937.—The saturation currents from a thin wire to a coaxial cylinder in an atmosphere of K vapour are measured as described earlier for Na vapour [see Abstract 927 (1935)]. If N_a atoms from one element A strike the surface of another element B in unit time and N_i of these are evaporated again, then the ratio N_i/N_a gives the degree of ionisation g. The value N_i is obtained by observing the current which flows from the wire to the cylinder. Results are as follows, for a rather thick Pt wire and a W surface $g = 43 \pm 3\%$, for very thin wires g (Pt—K) $= 51 \pm 3\%$ and g (K—W) $= 56 \pm 3\%$. Good agreement is found between these results and those of Killian and Meyer if equal values of vapour pressure are stipulated. It is suggested that deviations from theoretical values should not be considered until the differences of experimental values with vapour pressure are more clearly understood. H. M. B.

3789. Temperature Dependence of Oxygenation and Oxidation of a Tungsten Filament. M. C. Johnson and F. A. Vick. *Phys. Soc., Proc.* 49. *pp.* 409–418; *Disc.,* 418, *July* 1, 1937.—A distinction is made between two methods of using thermionic data to estimate for a filament surface the fraction which is covered with oxygen. Conditions are formulated under which either of the two gives approximations to the true fraction defined by concentration of particles in an adsorbed layer. In the method depending upon work functions the necessity for obtaining true instead of apparent thermionic constants for a composite surface is introduced, as these are found to differ widely for oxygenated tungsten. A set of experimental data is analysed by means of the two methods in turn, and empirical graphs are thence obtained representing approximately the temperature variation of the gas content of the surface. The limiting slopes to which these graphs tend in the valid portions of their respective ranges agree with the temperature coefficients of oxidation and oxygen evaporation known from other experiments. AUTHORS.

3790. Field Emission and Kathodic Dispersion of Thoriated Tungsten. E. W. Müller. *Zeits. f. Physik,* 106. 1–2. *pp.* 132–140, 1937.—The kathode is made of two W wires, one drawn and etched to an extremely fine point and the other bent to form a loop round this point [see Abstract 403 (1937)]. The apparatus is thoroughly degassed and for potentials from 2000–5000 V, currents from 10^{-9} to 10^{-5} A flow to the point, but no electrons are emitted by the surrounding loop. Th is either deposited upon the point or is incorporated in the tungsten as ThO_2 and then reduced and activated by heat. The empirical ϕ^3-law found for Ba-coated kathodes is confirmed for Th films. The Th is removed by bombardment with ions of A, H, and N and it is found that N can be adsorbed by the Th film but not by pure W. Bombardment with O_2 renders the Th film inactive and for such a treated kathode the work factor rises to 6 eV. The roughening of the W surface by dispersion causes a change in field strength which is expected from the geometric form. H. M. B.

See also Abstracts 3306, 3780.

THERMOELECTRICITY.

See Abstract 3707.